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Motive Power Department:

Modern Locomotive Valves and Valve Gears Analyzed 45
Interlocking Spring Rigging Developed on the T. & P..... 50
Automatic Water Softener..... 52
Relation between Draft and Evaporation..... 53

Car Department:

Metal Roof for Open-Top Cars..... 44

General:

Graphical Analyses of Mechanical Operations..... 39
Extensometer for Testing Materials..... 52
One Hundred Years Ago This Month..... 54

Editorials:

Efficiency and Economy..... 55
Robbing Peter To Pay Paul..... 55
Plan Now for Business Revival..... 55
Economies? 56
Something To Think About..... 56
What Does Technocracy Lead To?..... 57
New Books..... 57

The Reader's Page:

Locomotive Piping Practice..... 58
Stop That Waste!..... 58

Car Foremen and Inspectors:

Proper Care for Car Journals..... 59
Final Test for Air-Brake and Signal Hose..... 61
Reclaiming Couplers and Follower Blocks..... 62
A Portable Hand Shear..... 63
Decisions of Arbitration Cases..... 63
A Protective Coating for Workmen..... 64
Safety Tool for Hopper-Car Doors..... 64

Back Shop and Enginehouse:

Air Compressor Repairs on the Burlington..... 65
Reversing Valve-Bushing Press..... 67
Spot Welding the Stainless Steels..... 68
Mandrel for Air-Pump Valve Cages..... 69
Demonstration of Stellite Cutting Tools..... 69
Truck for Welding Equipment..... 70
Eccentric Drive for an Internal Grinder..... 70

Clubs and Associations..... 71

News..... 72

Index to Advertisers..... (Adv. Sec.) 18

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February - 1933

Graphical Analyses of Mechanical Operations*

By Lawrence Richardson†

The use of charts simplifies the problem of analysis and permits accurate control of operations

THE use of graphical charts has increased to such an extent that they are even more generally used than figures and tables. The eye can understand and absorb at one glance information that would require at least ten times longer to grasp from statistics and tables.

Graphical methods in railroads have been extended to shops, engine houses and car inspection points. With charts and graphs available, it is possible to visualize operations in a surprisingly short time that would otherwise take weeks of extended observations and long hours of work. It is uncanny how easy it is to see, in this way, when congestion occurs, man power necessary and possible ways of easing tight situations. With this method it is often possible to correct or improve conditions without the necessity of a personal inspection.

When capital expenditures are curtailed, it is even more necessary to devise methods and formulate plans to study all the possible economies. Usually by mapping

* The abstract of a paper presented before the Central Railway Club of Buffalo, N. Y., at a meeting at the Hotel Statler on October 13, 1932.

† Chief mechanical officer, Boston & Maine.

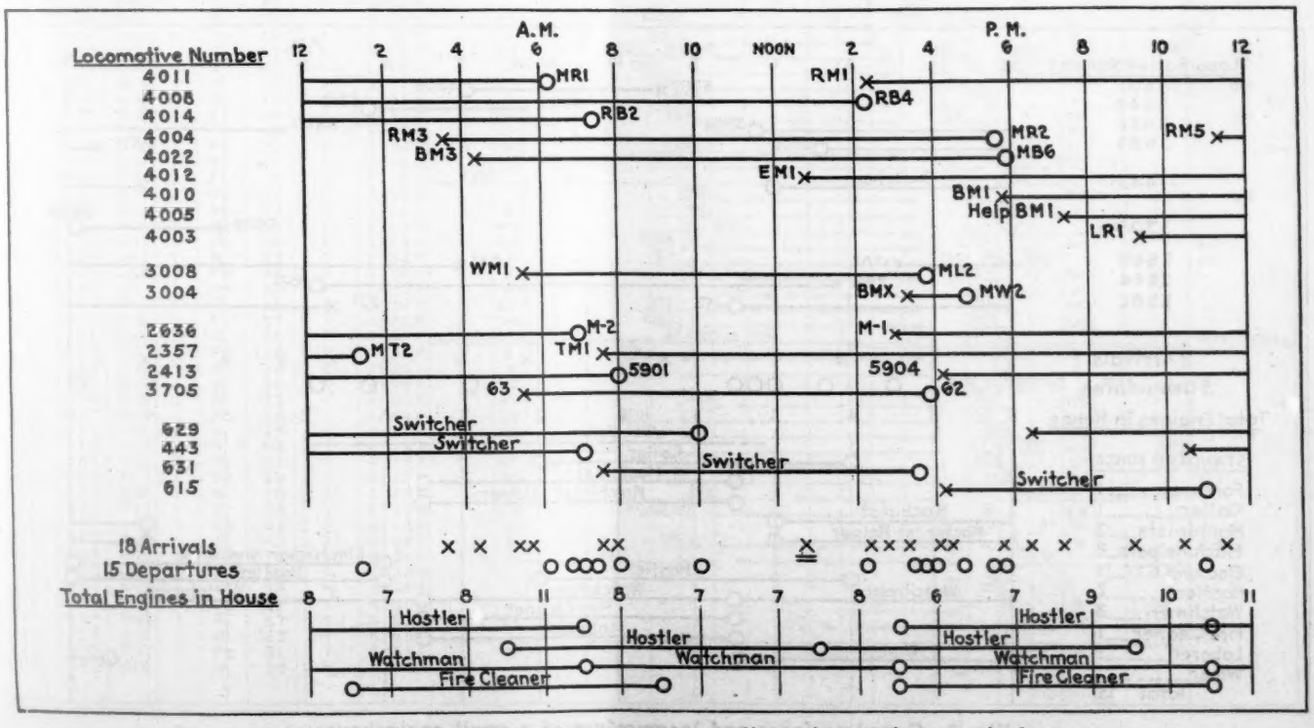


Fig. 1—Locomotive movements at a medium size engine terminal

out the problems graphically, whether it be a straight-line method of handling material in a shop, the spotting of freight cars on a repair track, or the handling of locomotives at a congested engine terminal, excellent results are invariably accomplished.

The principal charts used in enginehouse operations are those showing forces and locomotive movements.

filled with power, or moving the engine into the house immediately upon arrival and cleaning the fire on the outbound movement.

As each line represents a locomotive, the number for each hour can be seen and the number of watchmen can be definitely determined. For hostling, the crosses and circles determine the amount and the number. When

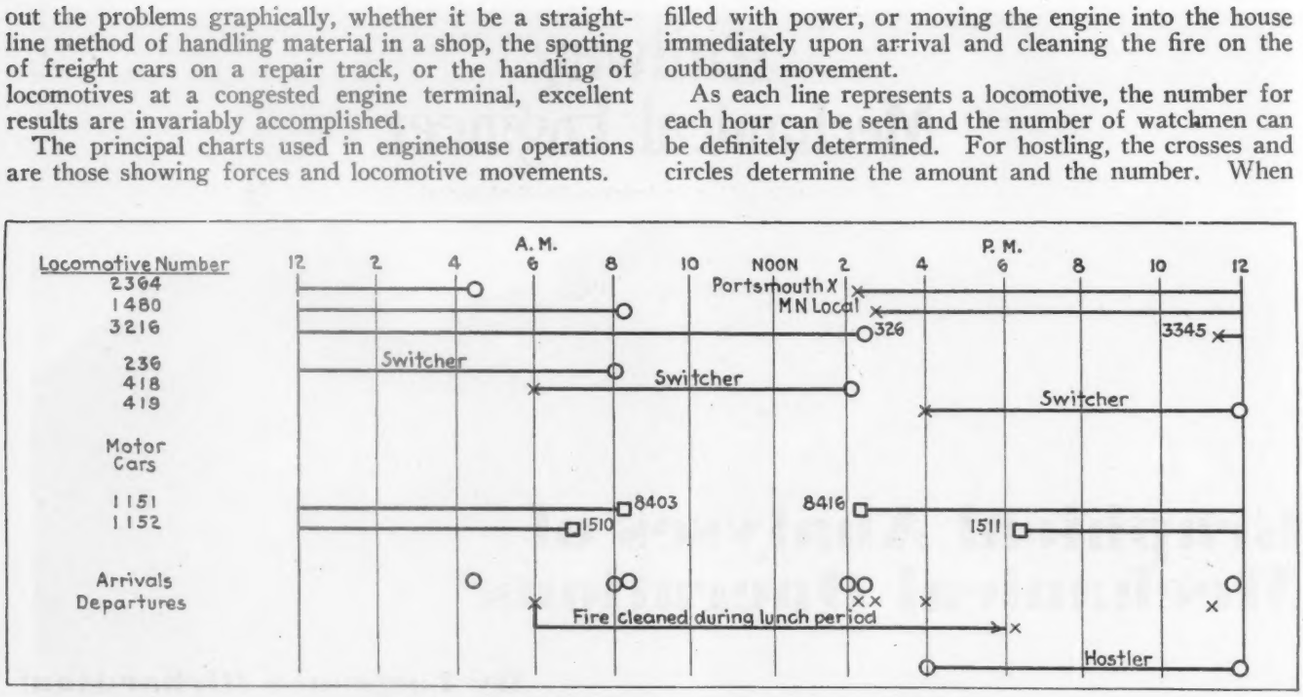


Fig. 2—Locomotive movements at a small enginehouse

Fig. 1 shows locomotive movements at a medium size engine terminal despatching 15 locomotives in the 24-hour period. The time of arrival of the locomotive is shown by a cross and the time of departure is shown by a circle. The sum and location of the arrivals and departures, crosses and circles, determine the organization, the number of fire cleaners, hostlers, watchmen, inspectors and mechanics needed and also the time when the maximum number of locomotives arrive and depart. When there are isolated crosses, as will be noted in the chart at 12:40 p.m. it can be determined, if economical operation can be best obtained by delaying the fire cleaning operation, either on the ashpit track, if the house is

there are several isolated circles they can be handled by having the hostler set out the locomotive on the outgoing track ahead of time or by having the engine crew take the locomotive out of the house. A similar inbound operation is possible with scattered crosses.

In this particular operation it will be noted that there are two distinct groups of movements and neither covers a full eight hours. The foreman puzzled at length as to how to cover the situation with only one additional hostler. The graphical chart clearly showed the answer to be a lapping of tricks. This gained the advantage of a split trick in effect without actually establishing one. When it is possible to handle a terminal with only one

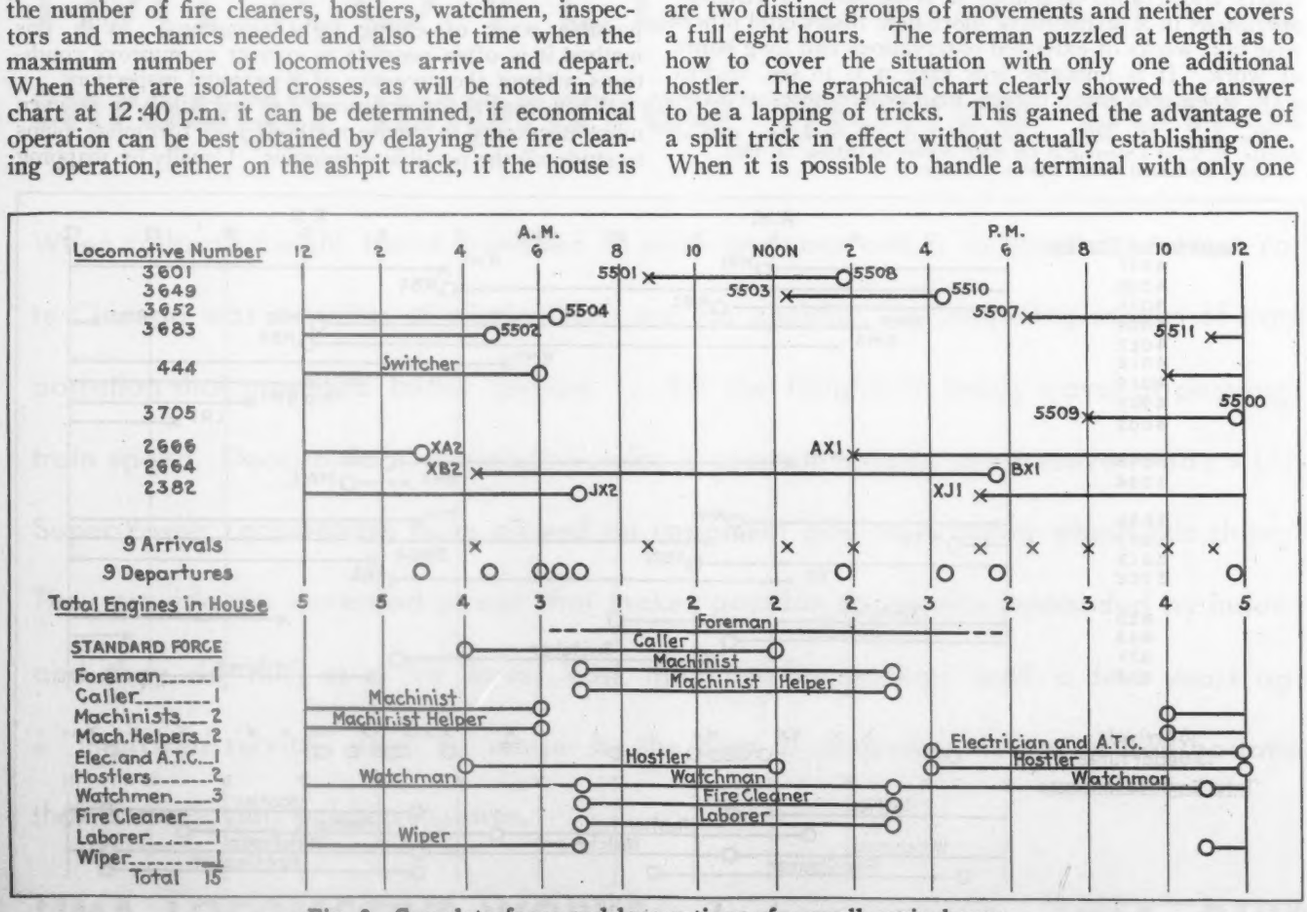


Fig. 3—Complete force and locomotives of a small enginehouse

or two engine-crew despatchers, the chart will show it and will determine the hours. When the number of mechanics is limited, particularly when there is only one of a class, such as an air-brake repairman, automatic-train-control man or electrician, the hours can readily be set. The chart is also helpful in determining the amount of supervision needed. This is especially so in the case of covering a house with two foremen without having to resort to the undesirable twelve hour trick.

Fig. 2 shows a small enginehouse operation. The interesting feature in this case was the matter of a shifter which would ordinarily have called for an extra hostler. A study of the chart showed that, except for the shifter, it was possible to concentrate all the work in one eight-hour period. The shifter was included in this shift by having it placed in the enginehouse during one of the lunch periods.

Fig. 3 shows the complete force and locomotive movements of a small engine terminal. Each man is represented by an individual line giving the hours on duty. The relation of the force to the operation will be seen.

In working out the consolidation of three enginehouses, after the building of the new terminal enginehouse at Boston, the use of various graphical charts was indispensable. This house is located three-quarters of a mile from North Station where 342 scheduled trains arrive and depart daily. On the north side of the engine terminal, less than a mile away, is located the hump and classification freight-car yards and on either side across the main line tracks are the passenger-car yards. At an engine terminal of this size, unless the movements in and out are studied and plans developed to relieve the peak periods, congestion is bound to occur resulting in inefficient operation.

This is a 50-stall enginehouse, with a total of 12 incoming and despatching tracks with cinder pits, coaling and sanding facilities servicing six tracks.

Fig. 4 shows train movements and enginehouse opera-

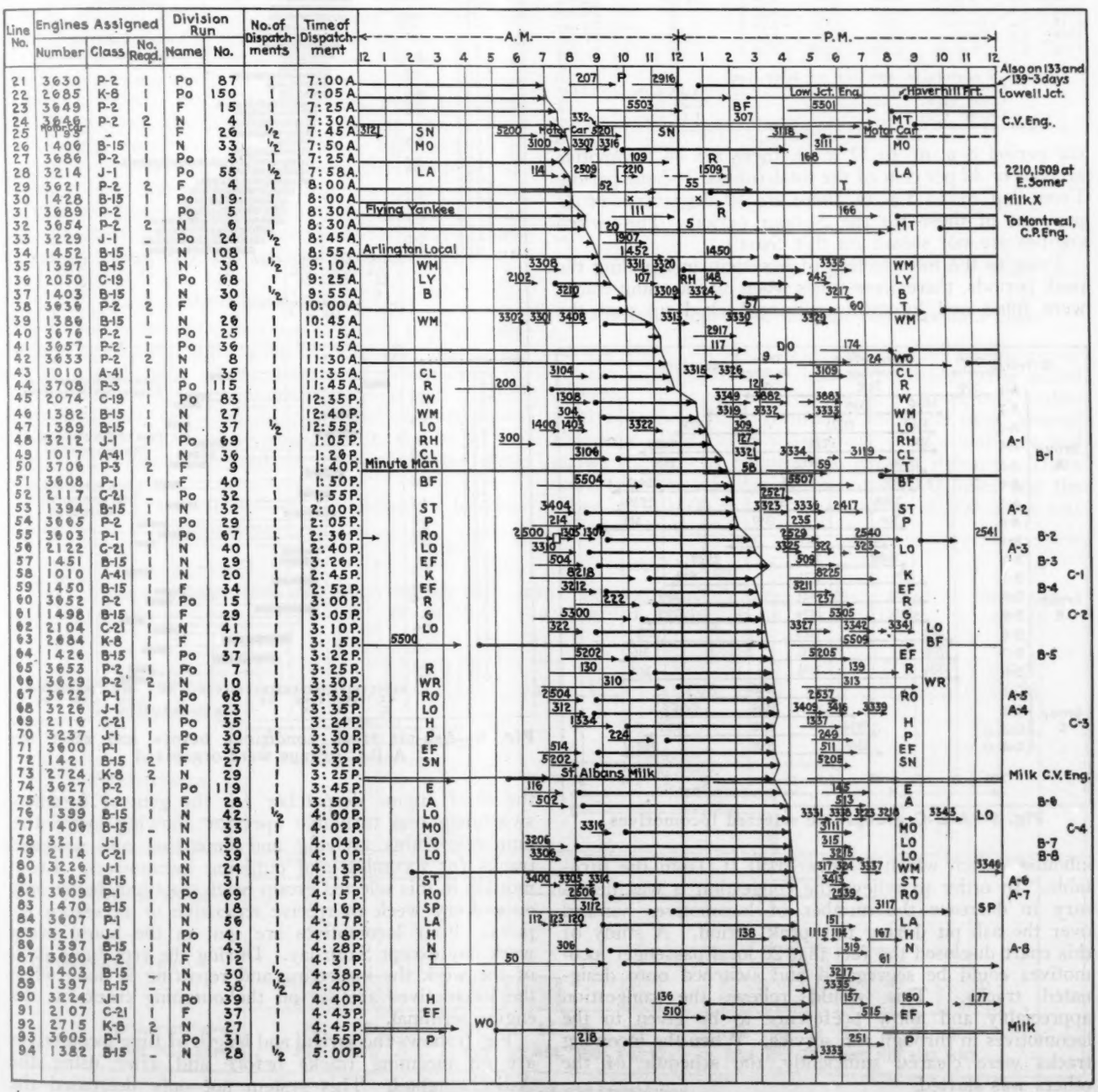


Fig. 4—Locomotive movements at the new terminal enginehouse—7:00 a.m. to 5:00 p.m.

tion for the period 7 a. m. to 5 p. m. The heavy black line represents the time the locomotive is in the terminal, the dot representing the arrival and the arrow representing the despatching time from the enginehouse. The light lines represent the running time of the train north and west and the return trains south and east. For

Table I—Track Assignment of A-B-C Groups

Locomotive No.	Symbol	Time due at term.	Train in	Train out	Crew on duty	Inbound put on track	Outbound put on track	Due repairs
3212	A1	7.10 A	300	127	1.05 P	6	9	Mon.
2114	B8	8.00 A	3306	3215	4.10 P	2-T-10	7	Wed.
3211	B7	8.00 A	3206	315	4.04 P	2-T-10	7	Wed.
2123	B6	8.10 A	502	513	3.50 P	2-T-10	7	Wed.
1394	A2	8.20 A	3404	3323	2.00 P	6	9	Mon.
2122	A3	8.30 A	3310	3325	2.40 P	6	9	Mon.
3226	A4	8.30 A	312	3409	3.35 P	6	9	Mon.
1426	B5	8.40 A	5202	5205	3.22 P	2-T-10	7	Wed.
3622	A5	8.45 A	2504	2537	3.33 P	6	8	Tues.
1385	A6	9.00 A	3314	3413	4.15 P	6	8	Tues.
1451	B4	9.15 A	3212	3211	2.52 P	2-T-10	7	Thurs.
2121	B3	9.45 A	504	509	3.26 P	2-T-10	7	Thurs.
3603	B2	9.15 A	1306	2529	2.36 P	2-T-10	7	Thurs.
3609	A7	9.15 A	2506	2539	4.15 P	6	8	Tues.
1397	A8	9.15 A	306	319	4.28 P	6	8	Tues.
1017	B1	9.40 A	3106	3321	1.26 P	2-T-10	7	Thurs.
1001	C4	9.50 A	3316	3111	4.02 P	2	1	Friday
2116	C3	10.00 A	1334	1337	3.24 P	2	1	Friday
1498	C2	10.30 A	5300	5305	3.05 P	2	1	Friday
1010	C1	10.45 A	8218	8225	2.45 P	2	1	Friday

Cleaning of engines to start out not later than:
Group A-1..... 11.30 a. m.
Group B-1..... 12.30 p. m.
Group C-1..... 1.30 p. m.

the period 8 a. m. to 11 a. m. there are 44 locomotive arrivals or 32 per cent of the total for the 24-hour period. From 2 p. m. to 5 p. m. there are 50 departures or 37 per cent of those for the 24-hour period. The switch engines are not shown on this chart.

Prior to the introduction of a system in handling the peak periods, there were times when all incoming tracks were filled and locomotives were backed up past the

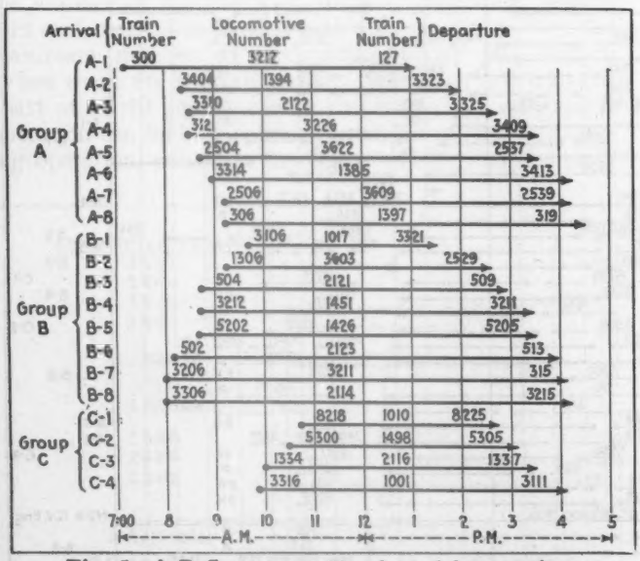


Fig. 5—A-B-C groups—20 selected locomotives

inbound switch which is only 1,050 ft. from the turntable. In order to relieve the congestion it was necessary to decrease the number of locomotives handled over the ash pit during this peak period. A study of this chart disclosed the fact that 20 local passenger locomotives could be segregated and switched onto designated tracks. This would relieve the congestion appreciably and allow preference to be given to the locomotives in through run service. When the incoming tracks were cleared sufficiently, the schedule of the others was started.

Fig. 5 shows the 20 selected locomotives arranged in groups; *A* with eight locomotives, *B* with eight locomotives and *C* with four locomotives. Each locomotive is designated by a symbol number A-1 to A-8, B-1 to B-8 and C-1 to C-4. Group *A* is composed of locomotives, first arrival and first departure and they are set on an incoming track in the order shown and turned and set out for despatchment on a selected track in the same order as they arrive at the turntable. Group *B* is made up of locomotives, first arrival and last departure, so it is necessary to make a second turntable movement by taking locomotives off the rear end of the line-up and despatch in time order. Group *C* engines are reversed in order at the turntable.

An A-B-C locomotive schedule is made out daily by

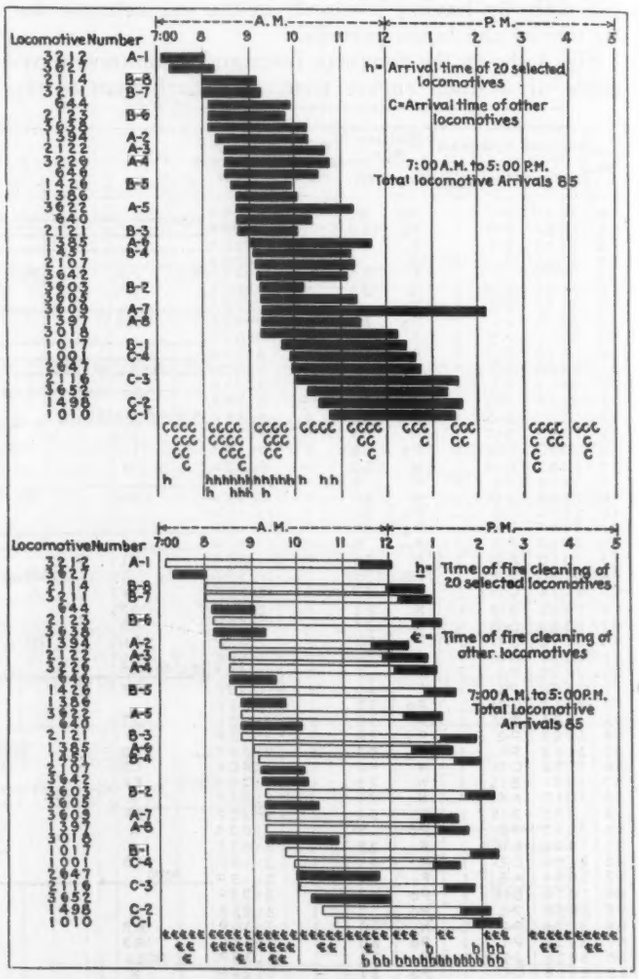

Locomotive Number
7:00 8 9 10 11 12 1 2 3 4 5
A.M.
P.M.
h= Arrival time of 20 selected locomotives
C=Arrival time of other locomotives
7:00 A.M. to 5:00 P.M.
Total locomotive Arrivals 85
h= Time of fire cleaning of 20 selected locomotives
C= Time of fire cleaning of other locomotives
7:00 A.M. to 5:00 P.M.
Total Locomotive Arrivals 85

Fig. 6—Ash-pit track conditions before and after the A-B-C groups were organized

the chief engine despatcher for the general foreman, switchman and turntable operator showing locomotive numbers, trains arriving and departing and assigned tracks for incoming and outgoing locomotives. Locomotives in this selected group reach the enginehouse only once every week to receive extensive or necessary repairs. Four locomotives are sent in the house every week day except Saturday. During the remaining days of the week the inspecting and repairing is done when the locomotives are set on the outgoing tracks at the engine terminal.

Fig. 6 shows the arrival and length of time locomotives are on incoming tracks before and after using the A-B-C method. This system not only decreased the average time on the incoming track from more than two

hours to less than one hour, but also greatly benefited the enginehouse organization by assisting in planning for the locomotives usually requiring more attention and repairs. In actual practice this method of operation entirely eliminated all congestion.

Furthermore, during the rush or peak load, the track capacity has been increased at least 70 per cent, which permits even a greater number of despatchments when occasion arises. With the present ease of the scheduled operations, the ultimate capacity of the enginehouse no doubt can be increased beyond original expectations.

Graphic Charts of Car Inspection and Shop Work

The use of graphic charts was later extended to an analysis of car inspection, used to determine the number of inspectors necessary, as well as the working hours. While only one chart is shown (Fig. 6), a thorough study requires a chart for a full week in order to take care of the variations in arrivals and departures. Where they do not fluctuate to any extent, the hours can be definitely set. However, leeway should be provided by arranging for proper notification of the foreman in case of unusual delays. The first move in making the chart is plotting of the time of arrivals on one line and the time of departures on another line. Then lines or blocks are drawn equal in length to the train minutes required. This is the number of cars, times the man-minutes per car, divided by two. Where there is no overlapping, two men are sufficient. Where there is appreciable overlapping, four or more men are required. In many cases the heavy demand in the receiving yard precedes the heavy demand in the departure yard. The *use* of a chart will readily show if the temporary transferring of men will cover this requirement.

Charting Costs

In shops the advantageous use of charts is principally confined to material and engine movements. The lining out on a scale plan of the shop of the movement of individual parts frequently discloses cross and reverse movements than can often be eliminated with resultant economy. In studying re-arrangement, the most advantageous moves can best be determined by these methods.

The use of graphical methods for individual locomotives, or groups, has been particularly helpful in establishing economical mileage between class repairs.

Fig. 8 shows a locomotive mileage and cost record which it is possible to keep up to date with a surprisingly small amount of clerical work. Mileage is used as a base and dollars as ordinates. Radial lines are drawn for each repair cost per mile. There is a 26-cent line, a 28-cent line, a 30-cent line and so on. The lines are readily drawn by the determination of a single point. With that and zero as the other point, a straight line is drawn. An average cost of 30 cents per mile at 50,000 miles would be $15,000. At 100,000 miles it would be $30,000. A check of each straight line will show the same relation to hold at any other point.

The cost record of an individual locomotive is shown

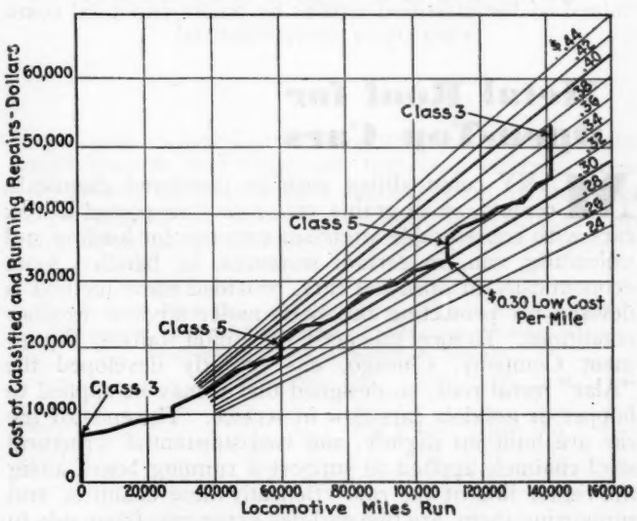


Fig. 8—Locomotive mileage and cost data chart

on the chart. It starts with the cost of a class repair at zero mileage, running costs and mileage being added monthly. It is essentially a curve of total cost versus total mileage. It is continued until the next general shopping. The curve shown covers an actual case and shows the loss by running too great a mileage. There were two Class 5 repairs, one at 60,000 miles and the other at 110,000 miles. The cost at 60,000 miles was

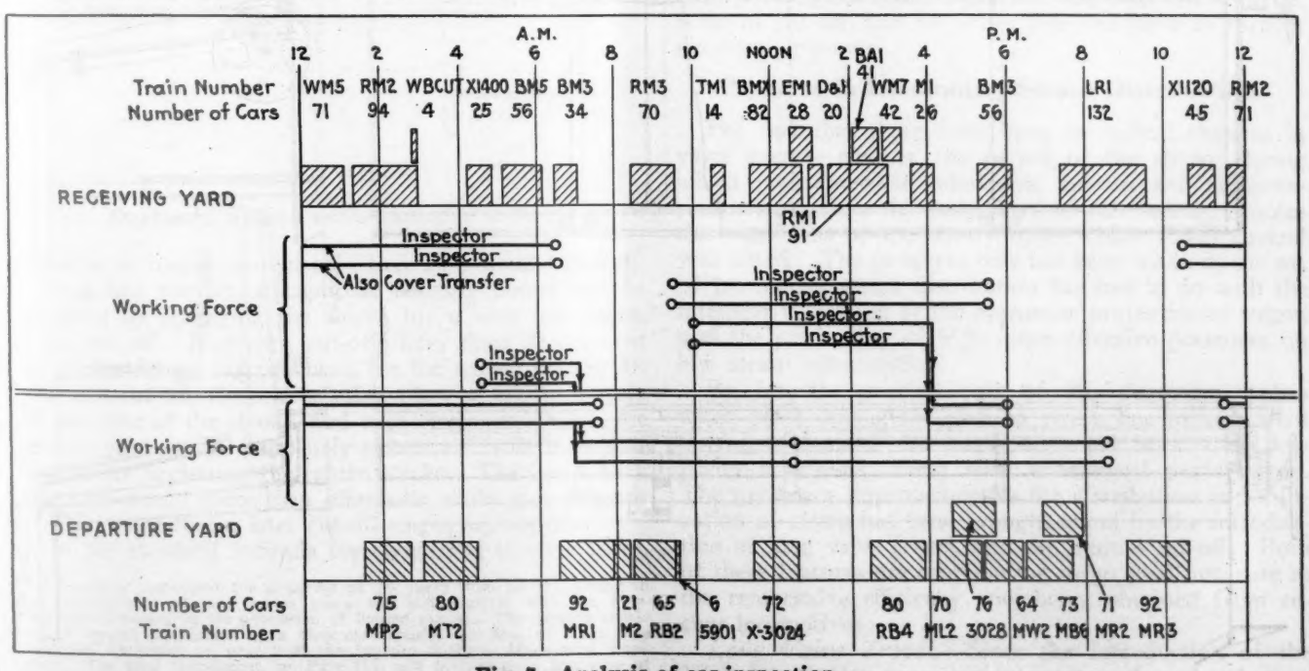


Fig. 7—Analysis of car inspection

31 cents per mile. The Class 5 repair at this point fully justified itself because the cost dropped to 30 cents at 110,000 miles. However, the Class 5 repair at this second point did not justify itself because the cost only dropped back to 32 cents, when it was necessary to shop for a Class 3 repair. The actual loss was 2 cents over the entire 142,000 miles, or $2,840.

With charts of each locomotive periodically checked, they are particularly useful in determining the economical mileage of each class as well as the proper shopping of each individual locomotive.

On the reverse side of the card a record is kept of the monthly mileage and monthly costs added, the totals only being posted on the chart. A record is also maintained of the classified repairs by points and total costs.

Metal Roof for Open-Top Cars

MANY commodities, such as powdered chemicals, cement, small grains, etc., now transported in box cars with considerable attendant expense for loading and unloading, can, in certain instances, be handled more economically in open-top cars, provided some method is devised for protecting the loads under adverse weather conditions. To meet this need, the Union Railway Equipment Company, Chicago, has recently developed the "Alar" metal roof, so designed that it may be applied to hopper or gondola cars now in service. The ends of the car are built up slightly, and two substantial structural steel channels applied to support a running board along the center line of the car. Beneath these channels, and supporting them, are two carlines extending from side to side of the car and riveted to the center channels.

The roof is thus divided into two sections, one on either side of the running board and each having its individual operating mechanism for raising and lowering. By reference to the drawing, it will be observed that there is a wheel on the end of the car on the opposite side from the brake wheel which operates a power unit composed of a series of gears which in turn rotate the operating rod extending from end to end of the car.

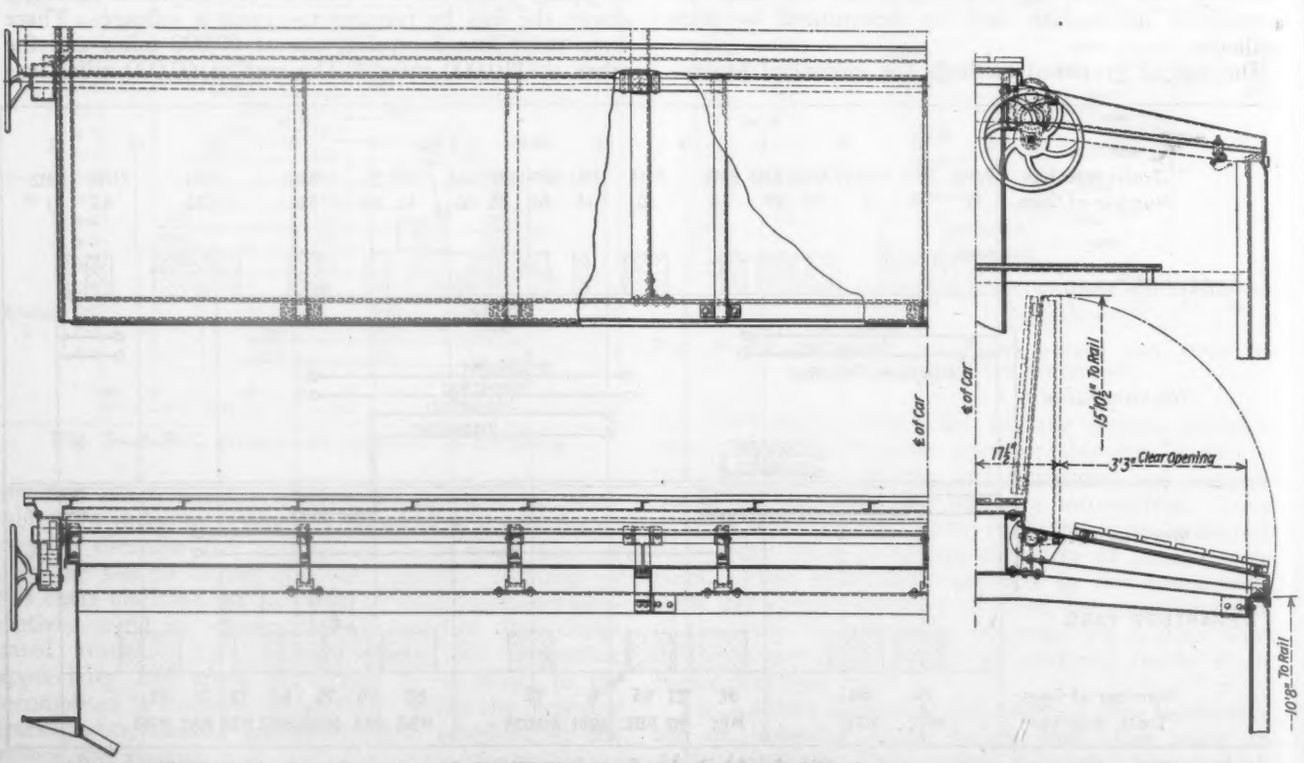
To this rod are secured the arms or wings supporting the roof sheets, and these arms rest at the outer side of the roof in pocket castings designed to prevent any shifting in the roof at that point. The operating rod is secured not only to the ends of the car, but also at intermediate points, by means of brackets on the carlines. A few turns of the hand wheel will raise the roof on that side of the car to a vertical position at right angles with the running board and provide an open space of approximately 3½ ft. in width, the full length of the car, for loading purposes.

Each side of the roof relative to the running board is operated independently. A ratchet and pawl are also provided to retain the roof in the raised position. A steel hasp and hook is provided at each end of the car on either side for sealing the roof in the closed position.

The roof sheets are formed at the running board, at the eaves and at the ends of the car to prevent moisture or foreign particles getting into the interior of the car. At each end of the car a vertical channel is applied, to which the longitudinal channels, as well as the housing for the operating mechanism, are riveted.

Railroads experience considerable losses, due to the pilfering of coal or other commodities loaded in open-top hopper cars, and considerable labor expense is involved during winter in unloading materials which are exposed to the weather. The new "Alar" metal roof is designed to meet these conditions by preventing losses and effecting economies in the expense of loading and unloading.

LOADED TRUCKS MOVED ON FLAT CARS.—The Chicago, North Shore & Milwaukee has established a merchandise service between Chicago and Milwaukee, Wis., whereby loaded auto-trucks and trailers are carried on flat cars. The trucks or trailers as received from shippers on trucking companies, are mounted on specially designed flat cars where they are blocked in place and forwarded to destination.



Alar metal roof developed by the Union Railway Equipment Company for use on hopper and gondola cars

Modern Locomotive Valves And Valve Gears Analyzed

Part II

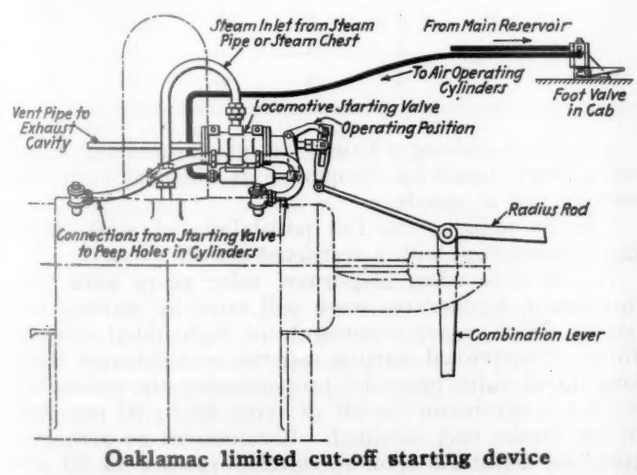
By Walter Smith*

A study of the effect of limited cut-off and long valve travel on locomotive capacity

FROM the standpoint of steam distribution, the maximum cut-off is by far the most important factor in effecting starting capacity. Maximum tractive force is the measure of starting capacity, and is obtained with the highest possible mean effective pressure in the cylinders. At starting, and at very slow speeds, high m. e. p. is the result of long cut-offs.

The proportion that the sum of steam lap and lead bear to the total valve travel is what determines the per cent of maximum cut-off. The greater per cent the lead bears to the sum of lap and lead, the later will be the maximum cut-offs. Assuming that a maximum cut-off of at least 85 per cent of the stroke is required for starting reliability, the sum of lap and lead cannot be greater than 20 per cent of valve travel.

From the foregoing, it is evident that an increase in either steam lap or lead will cause too early a maximum cut-off unless the valve travel is properly proportioned. As lead is necessarily more or less of a constant, variations in steam lap have by far the greatest influence on the maximum cut-off. It is thus proportioning the steam lap, and to a slight extent the lead, to the valve travel that makes it possible to obtain easily any desired re-


Steam Inlet from Steam Pipe or Steam Chest
From Main Reservoir
To Air Operating Cylinders
Foot Valve in Cab
Vent Pipe to Exhaust Cavity
Locomotive Starting Valve Operating Position
Radius Rod
Connections from Starting Valve to Peep Holes in Cylinders
Combination Lever

Oaklamac limited cut-off starting device

striction in maximum cut-off—that is, a limited cut-off.

In a like manner, exceptional starting power can be obtained by arranging the valves for a very late maximum cut-off. However, cut-offs later than 90 per cent of the stroke are not practical, for the reason that at 90-per cent cut-off, the release takes place at approximately 96 per cent of the stroke, and with release still later, the steam could not be completely exhausted from the cylinder before beginning the return stroke. The initial back pressure would more than offset the slight gain in positive pressure that a later cut-off might accomplish.

In the standard formula for computing tractive force, 85 per cent of boiler pressure is used, arbitrarily, as the factor because that represents the mean effective pressure usually obtained with a maximum cut-off of about 85 per cent of the stroke. However, a higher per cent of boiler pressure should be used for calculating tractive force for the locomotives in which the maximum cut-offs are later. Numerous tests have demonstrated that, with a maximum cut-off of from 88 to 90 per cent of the stroke, a factor of 90 per cent of boiler pressure can safely be used.

Table I—Trend Toward Longer Valve Travel Since 1905 Shown by Typical Examples of Valve Arrangements—Measurements Expressed in Inches

	1905	1909	1912	1915	1923	1927	1930
Travel	5½	6	6½	7	7½	8½	9
Steam lap	1⅛	1	1 1/16	1 1/16	1¼	1 1/16	1 1/16
Lead	¼	1/16	¼	¼	¼	⅛	⅛
Exh. clear	⅛	⅛	⅛	⅛	⅛	⅛	⅛

By starting reliability is meant the initial revolution of the wheels. Without question, very late maximum cut-offs make for starting reliability, because with a locomotive at rest the chances are greatly in favor of both cylinders taking steam; while with shorter maximum cut-offs the chances are that one side will be at the point of cut-off, and the other side will have to furnish the starting power.

Progress in Locomotive Steam Distribution

The fact that there have been no radical changes in valve events—that is, the period of the stroke during which pre-admission, admission, release and compression occur—since the early days of railroading, denotes the soundness of the theory upon which steam control was based. The progress that has been made in the art of locomotive steam distribution has had to do with the intensive utilization of the expansive properties of steam, and the production of high mean effective pressures on low steam consumption.

By far, the greatest part of this development has taken place during the past 15 years, due to an urgent operating demand for high sustained horsepower capacity at speeds, along with economical performance. The necessary improvement in the distribution and utilization of steam has been brought about by the introduction of long valve travel, and the limited cut-off. Both of these features are contributing in no small measure to the remarkable efficiency now being obtained from recent locomotives.

Long Valve Travel.—Since the introduction of the Walschaert valve gear in this country, there has been a

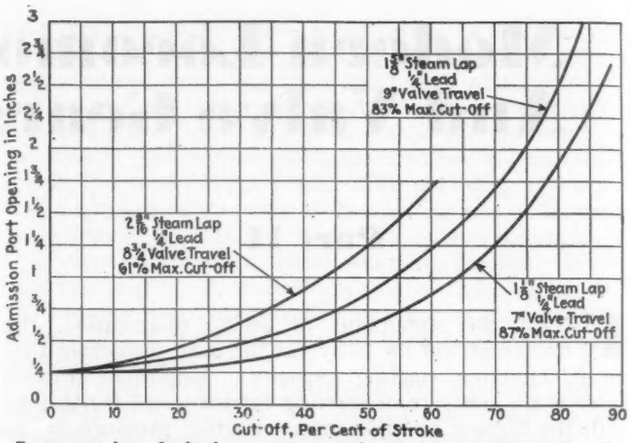
* Formerly associated for a period of 14 years with O. W. Young in the development of long travel gears and subsequently with the Pyle-National Company in the promotion of limited cut-off. The present article is the second installment of a three-part article, the first of which was published beginning on page 9 of the January *Railway Mechanical Engineer*. The final installment, or Part III, will include an explanation of the limitations and possibilities of steam distribution valves.

distinct trend toward longer valve travel, as shown in Table I. While the first extremely long-travel valve gear was introduced in 1915, it was 10 or 12 years later before the practice of using long travel became well established.

The credit for pioneering the use of long valve travel must be given to O. W. Young, whose ideas for the utilization of exceptionally long valve travel, and a wide steam lap, were embodied in the Young valve gear which was first applied in 1915. The first applications of the Young gear were made with 8½-in. travel, and about four years later, the gear was redesigned for a 9-in. travel.

With few exceptions, valve travel in excess of 9 in. has not been used. One notable exception is the new Santa Fe 2-10-4 type locomotive which has 9⅞-in. valve travel, and valves arranged for the extraordinarily wide steam lap of 3 in. This valve and valve-gear arrangement probably represents the full travel possibilities of our present valve gears.

The introduction of extremely long valve travel was an outstanding development in valve-gear design. This feature affords a very simple and desirable means of increasing horsepower output, and has been an important factor in effecting the increased horsepower capacity of recent locomotives. Greatly increased valve travel, with proportionately increased steam lap, economically increases cylinder power.



Increase in admission port openings accomplished by the limited cut-off and long-travel valve arrangements

Long valve travel can be used to enlarge the capacity of a locomotive in the following ways:

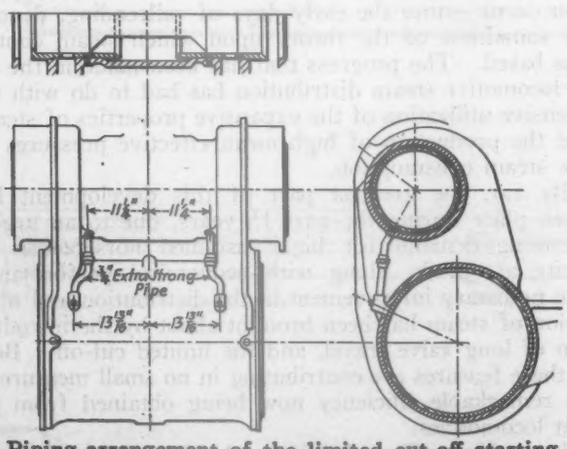
(1) By lengthening the full-gear cut-off, and thus increasing the maximum tractive force.

(2) By maintaining the same maximum cut-off, and raising the horsepower output by widening out the steam lap.

Table II—Record of Valve Events for Elliptical Diagram Showing Long-Travel Valve Movements

Line No.	Measured on piston stroke, in.									Measured on valve, in.				
	Cut-off			Release		Compression		Pre-admission		Lead		Port opening		Valve travel
	Per cent	F	B	F	B	F	B	F	B	F	B	F	B	
1	88.4	25	24½	26⅞	26⅜	11/16	⅜	0	0	1/4	1/4	2 1/4	3	8 1/4
2	83.0	23½	23	26⅜	26¼	1⅝	1⅝	1/4	1/4	1/4	1/4	2 1/4	2⅝	7 1/4
3	73.0	20¾	20¼	25⅛	24⅝	2½	2⅛	1/4	⅛	1/4	1/4	1 1/4	1 1/4	5⅜
4	52.0	14⅝	14¾	22½	22⅛	4¾	4⅜	1/4	⅜	1/4	1/4	11/16	¾	4 1/4
5	26.0	7⅝	7¾	18¾	17⅜	8½	7⅜	11/16	⅜	1/4	1/4	11/16	11/16	3½

There is some misunderstanding as to the benefits to be derived from long valve travel. An increase in valve travel without a proportional increase in steam lap has no effect whatever on the short-cut-off valve action. It merely adds to the over-travel of the valves in full-gear, and gives a later maximum cut-off. However, when increased travel is utilized to widen out the steam lap the short cut-off valve events are much improved, due to wider port openings and higher valve velocity.



Piping arrangement of the limited cut-off starting ports

(3) By combining a longer cut-off and a wider steam lap a more powerful locomotive is obtained both for starting and at speeds.

(4) By utilizing the full possibilities of wide steam lap in connection with a restricted cut-off.

At the time when long-travel valve gears were first introduced, locomotives were still rated by starting capacity, which meant a demand for high initial tractive force. Exceptional starting capacity was obtained from long-travel valve gears by proportioning the steam lap so that a maximum cut-off of from 88 to 90 per cent of the stroke was obtained. Locomotives so arranged could be depended upon to develop from 6 to 10 per cent more than their calculated tractive force, due to the fact that the mean effective pressure developed was about 96 or 97 per cent of initial pressure. Valves arranged for the widest steam lap will utilize the greatest per cent of initial pressure, because of more liberal exhaust openings which reduce the choking effect from a very late release.

High Sustained Speeds Now of Primary Importance

The former demand for high initial tractive force has been superseded by the necessity for high sustained speed. For this reason, there is a growing tendency to use a shorter maximum cut-off than that formerly considered necessary, and to use the long valve travel as a means of increasing the steam lap. The additional starting capacity derived from the booster has helped to make

this arrangement practical. A notable example of this recent practice is the new Chesapeake & Ohio 2-10-4 type locomotives, which have valve gears with 9-in. travel with distribution valves arranged for 1-15/16-in. steam lap, and an 80-per cent maximum cut-off.

The most efficient and economical valve arrangement is the one with as wide a steam lap as the permissible maximum cut-off will allow. Tests have shown conclusively that locomotives with long-travel valve gears, and valves arranged for wide steam lap, can be depended upon to develop a much greater percentage of their rated power at speed than the conventional narrow-lap arrangement. As much as 10-per cent increase in horsepower has been shown in favor of the wide-lap setting. The necessity for wide-lap valves and long-travel valve gears is apparent if liberal horsepowers are to be obtained.

Table III—Comparison of Valve Events, Travel, Port Openings and Port Areas, Showing Improvement Effected by Long Travel over Conventional Arrangement—Hudson Type Locomotive, Cylinders 25 In. by 28 In.

	Conventional, in.	Long travel, in.
Valve arrangement		
Valve diameter	14	12
Valve travel	7	9
Steam lap	1 1/8	1 3/8
Lead	1/4	1/4
Exhaust clearance	1/8	1/8
Width of valve port	1 5/8	2 1/8
Exhaust opening—end of stroke	1 1/2	2
Exhaust port area—end of stroke	50.9 sq. in.	57.4 sq. in.
Valve events, full gear		
Cut-off	24	23 1/2
Release	26	26 1/4
Closure	1 1/16	1 1/8
Pre-admission	1/16	1/16
Maximum cut-off	87 per cent	84 per cent
Valve events, travel, port openings and port areas (25 per cent cut-off)		
Cut-off	7	7
Release	17 1/4	17 3/4
Closure	7 7/8	8
Pre-admission	1/8	7/8
Valve travel	2 1/8	4
Increase in travel velocity	....	39 per cent
Admission port opening	1/16	1/16
Admission port area	10.6 sq. in.	12.55 sq. in.
Exhaust port opening	1 1/16	2 1/8
Exhaust port area	53 sq. in.	60.98 sq. in.

The improved cylinder performance accomplished by wide steam lap is due to the following features:

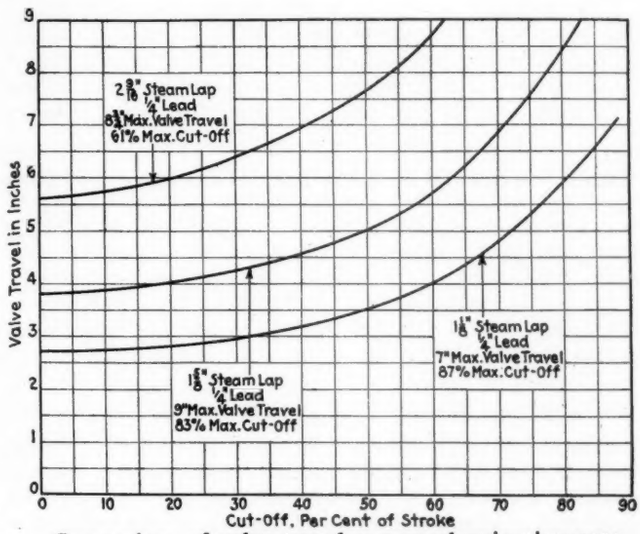
(1) Wide port openings for both admission and exhaust, particularly in the early cut-offs.

(2) Increased valve travel, greater valve velocity, quicker full port opening, and longer duration of the maximum port opening.

(3) More accurate timing of valve events, steam volumes to and from the cylinders more positively governed, more decisive control of steam distribution, and piston pressures more accurately gaged.

(4) Decreased influence from lost motion and faulty valve adjustments.

(5) Higher mean effective pressure at all points of cut-off.



Comparison of valve-travel curves, showing increase effected by wide steam lap

(6) Less pre-admission, for a given lead, at all points of cut-off.

(7) Full and free pre-release, resulting in a lower back pressure.

(8) Exhaust clearance reduced in proportion to increase in steam lap, resulting in a later release, longer expansion period, and better control of compression.

One of the elliptical diagrams gives a graphic picture of the long-travel valve movement in its relation to piston stroke. The data necessary for an analysis of this diagram is given in Table II. In order to show the improvement in velocity, port openings, and port areas accomplished by long valve travel and wide steam lap, a comparison is shown in Table III between the conventional and long-travel arrangements. Typical examples of the valve and valve-gear arrangements used on modern locomotives are shown in Table IV, and indicates the decided tendency toward long-valve travel.

The enlarged capacity obtained from long-valve travel has fully justified its use, but here as elsewhere, the law

Table IV—Valve and Valve-Gear Arrangements, Typical Examples of Modern Locomotives

Railroad	Nor.Pac.	C.R.I. & P.	C. & N. W.	D. & R. G. W.	A. T. & S. F.	Wabash	L. V.	T. & P.	N.Y.C.	C.N.R.	N.Y.C.	C. M. St. P. & P.	C. St. P.M.&O.	Erie	C. & O
Type	4-8-4	4-8-4	4-8-4	4-8-4	4-8-4	4-8-4	4-8-4	4-8-2	4-8-2	4-6-4	4-6-4	4-6-4	4-6-2	2-8-4	2-10-4
Year built	1926	1929	1929	1929	1928	1931	1931	1928	1929	1930	1930	1930	1930	1927	1930
Boiler pressure, lb.	210	250	275	240	210	250	250	215	225	275	225	225	260	225	260
Cyls., diam. and stroke, in.	28 by 30	26 by 32	27 by 32	27 by 30	30 by 30	27 by 32	27 by 30	27 by 30	27 by 30	23 by 28	25 by 28	26 by 28	25 by 28	28½by32	29 by 34
Driving wheel diameter, in.	73	69	76	70	73	70	70	73	69	80	79	79	75	70	69
Tractive force, lb.	57500	66000	71800	63700	66000	70817	66400	54700	60000	43300	42400	45820	51566	70000	91584
Valve, gear, type	Baker	Baker	Walsch.	Walsch.	Walsch.	Walsch.	Walsch.	Walsch.	Baker	Baker	Baker	Baker	Baker	Baker	Baker
Piston valve diameter, in.	14	12	14	14	15	12	12	14	14	12	14	14	12	14	14
Maximum valve travel, in.	9	8 5/8	8	7	9	8	7 1/2	7 1/2	9	9	9	9	9	9	9
Steam lap, in.	1 3/8	1 5/8	1 5/8	1 1/4 Variable	1 5/8	1 5/8	1 3/8	1 1/4	1 3/8	1 1/8	1 1/8	1 5/8	1 5/8	1 3/4	1 11/16
Valve lead, in.	1/4	1/4	1/4	0–3/8	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
Exhaust clearance, in.	1/8	0	1/8	1/8	1/8	1/8	1/8	1/8	0	1/4	1/4	1/8	1/8	0	0
Max. cut-off, full gear, per cent	89	82	81	87	89	86	84	86	84	88	87	89	83	81	80
Valve travel, 25 per cent cut-off	3 7/16	4 1/16	4 1/16	3 3/8	3 1/4	3 1/4	3 1/4	3 7/16	4	3 11/16	3 3/4	3 1/4	4 1/16	4 1/16	4 11/16
Admission port opening, 25 per cent cut-off	11/16	11/16	11/16	1/16	3/8	3/8	3/8	11/16	1/16	11/16	1/16	3/8	11/16	11/16	11/16
Exhaust opening, max., 25 per cent cut-off	1 11/16	2 1/16	2 1/16	1 11/16	1 7/8	1 7/8	1 7/8	1 11/16	2	2 1/16	2 1/16	1 7/8	2 1/16	2 1/16	2 11/16
Exhaust opening, end of stroke	1 3/4	1 7/8	2	1 5/8 Full gear; 1 3/4–25% C.O.	1 3/4	1 3/4	1 3/4	1 11/16	1 7/8	1 11/16	2	1 3/4	2	2	2 1/8

of compensation takes its toll. Naturally, long valve travel puts additional stress on the valve gear, and may be expected to increase the wear and tear; also, more power is required to operate the valves with more wear of the valves and bushings.

Effect of Limited Cut-Off on Power Output at High Speeds

The limited cut-off is a very interesting advance in the science of locomotive steam distribution and utilization. This development has been an important factor in increasing power output at speed with economical performance. It is generally conceded that the efficient utilization of high-pressure steam is a matter of using steam expansively, and the limited cut-off insures the expansive use of steam throughout the whole range of operation. It takes full advantage of steam expansion as an economy and power-increasing factor.

While a large part of the fuel economy is due to the reduction in cut-off made possible by the higher boiler pressure, a significant part of it is due to the better valve performance accomplished by the increase in steam lap. An increase in steam lap always means a shorter cut-off, and a longer expansion period for a given valve travel. From the foregoing, it is apparent that the best possible arrangement is obtained with the widest steam lap and longest valve travel.

An even turning moment with reduced maximum variation in torque is characteristic of limited cut-off locomotives. This feature makes a lower factor of adhesion possible, and contributes to smooth working conditions, which, in turn, reduces the wear and tear on the running gear. The quarter slip of drivers, which is common to full-stroke locomotives when the cranks reach a position 45 degrees from dead center, is practically eliminated.

A study of crank leverages and relative piston pressures shows clearly the necessity for late maximum cut-offs to insure starting reliability. With a locomotive in position for both cylinders to take steam, there will be no difficulty in starting, but if one side is at the point of cut-off, its opposite cylinder must provide starting power, and with cut-offs too early, the crank angle will be too slight to revolve the wheels. For this reason, locomotives which are strictly in the limited cut-off class cannot be depended upon to start a train in all crank positions, unless some auxiliary means is provided to admit steam to the cylinders beyond the point of cut-off. As a general rule, locomotives are not considered in the limited cut-off class unless the maximum cut-off is restricted to less than 80 per cent of the stroke.

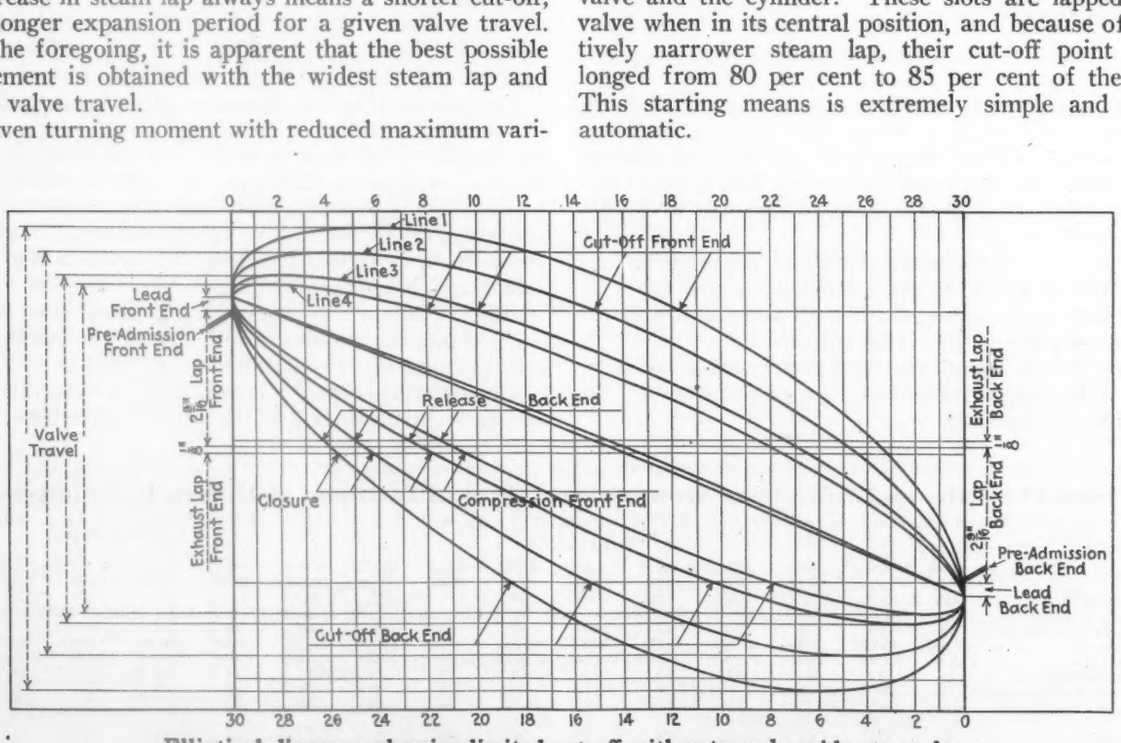
The following arrangements have been devised to provide the necessary starting means for limited cut-off locomotives:

The Franklin Limited Cut-Off Device.—This device provides small starting ports in the valve bushings, which communicate with the main steam passages between the valve and the cylinder. These slots are lapped by the valve when in its central position, and because of a relatively narrower steam lap, their cut-off point is prolonged from 80 per cent to 85 per cent of the stroke. This starting means is extremely simple and entirely automatic.

The Chapman-Lanning Auxiliary Starting Valves.—This device also provides starting ports, but the auxiliary steam is by-passed through plug valves which can be opened and closed from the cab in the same manner as cylinder cocks. Due to the fact that the auxiliary admission can be cut out when not required, it is possible

Table V—Record of Valve Events for Elliptical Diagrams, Showing Limited Cut-Off with Wide Steam Lag

Line No.	Measured on piston stroke, in.									Measured on valve, in.				
	Cut-off			Release		Compression		Pre-admission		Lead		Port opening		Valve travel
	Per cent	F	B	F	B	F	B	F	B	F	B	F	B	
1	61.3	18¼	18⅝	26 11/16	26¼	4 1/16	3¾	1/16	1/32	¼	¼	1 11/16	2 3/16	8 11/16
2	50.0	14⅞	15⅛	25 1/16	25	5¾	5 1/16	⅛	1/32	¼	¼	1 1/16	1 11/16	7 13/16
3	33.7	10	10¼	23½	22¾	8¼	7⅜	1/16	1/32	¼	¼	11/16	11/16	6 7/16
4	26.3	7 11/16	7⅛	22 1/16	21 1/16	9⅝	8 9/16	¼	1/16	¼	¼	11/16	11/16	6 1/16

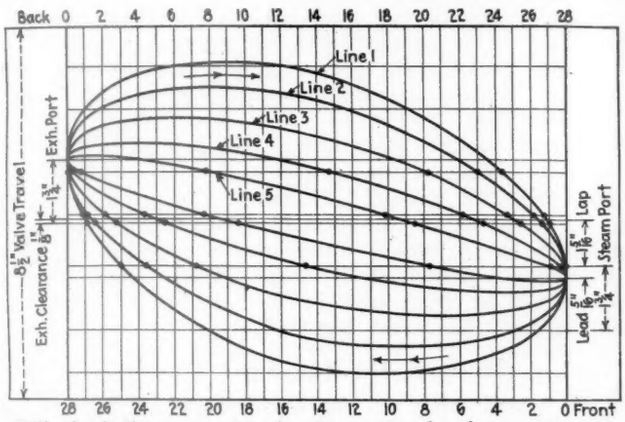


Elliptical diagrams showing limited cut-off with extremely wide steam lap

to use larger starting ports with this valve arrangement.

The Pyle-National Duplex Limited Cut-Off Valves.—In this arrangement provision for auxiliary admission for starting is made in the distribution valves. Small auxiliary ports are so arranged that steam is admitted to the cylinders after the main port has closed, and thus the cut-off is restored to 80 or 85 per cent of the stroke. This device is entirely automatic and involves no complication.

The Piping Arrangement of Starting Ports.—This device differs from the ordinary starting port arrangement in that the auxiliary admission from the ports in the valve bushings is piped directly to the cylinder barrel. The pipe is tapped into the cylinder at or near the


Back 0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Line 1
Line 2
Line 3
Line 4
Line 5
Exh. Port
Valve Travel
Exh. Clearance
Lap
Steam Port
Lead
28 26 24 22 20 18 16 14 12 10 8 6 4 2 0 Front

Elliptical diagrams showing long-travel valve movement

end of the stroke. This prevents the undesirable pre-admission of steam which is characteristic of the conventional auxiliary port arrangement.

The Oaklamac Limited Cut-Off Device.—This device, which was developed on the Monon, provides separate starting valves. These starting valves are located directly over the main valve chambers, and are actuated by an ingenious mechanism which derives its motion from the combination lever. Normally, this gear idles and the starting valve covers the ports. The mechanism is cut in by an air cylinder which is controlled by a foot pedal in the cab. This device positively controls the auxiliary admission, and, due to the fact that pre-admission is almost entirely eliminated, the starting valves can be arranged for a cut-off as late as 90 per cent of the stroke.

The Reverse-Lever Arrangement for Limited Cut-Off.—This device makes it possible to obtain a restricted maximum running cut-off when the valves and valve gear are arranged for a full stroke cut-off. The full stroke cut-off is made available for starting by a novel reverse-lever arrangement. The quadrant is only graduated to the extent of the restricted cut-off, and is provided with a spring stop, which makes it possible to move the lever further over to full-stroke position, if it is held by hand against spring compression.

When a long-travel valve gear is used in connection with the limited cut-off, it is possible to arrange the valves for extremely wide steam lap. The ellipses, shown in one of the illustrations, indicate clearly the decided improvement in valve movement accomplished by this arrangement. The corresponding data for these diagrams are shown in Table V. Additional curves, illustrated in the article, show the increase in port opening, and valve travel, at all points of cut-off, effected by wide steam lap, which is made possible by the limited cut-off arrangement. Typical examples of limited cut-off valve and valve-gear arrangements are shown in Table VI.

A Royal Railroad Enthusiast.—Boris of Bulgaria is a King, but he shares an enthusiasm for railroading with many commoners. He gave evidence of this enthusiasm recently when he granted a private audience to Augustus Phillips, a locomotive engineer from Falls City, Neb., who had returned to his native Bulgaria for a vacation.

"You know, railroading is my hobby," said King Boris during the course of the conversation. "We never have a new engine over here but that I pull the throttle and start the train going, just as your executives and statesmen launch merchant vessels and battleships."

The King and the locomotive engineer then discussed the merits of standard gage and narrow-gage track, and agreed that the narrow gage is unsatisfactory. King Boris also asked Mr. Phillips' advice about putting automatic stokers on Bulgarian engines. Mr. Phillips advised waiting until larger locomotives were in service and with this the King agreed, but possibly there is a lead here for some energetic stoker salesman.

Table VI—Valve and Valve-Gear Arrangements, Typical Examples of Limited Cut-Off Locomotives

Railroad	Timken	D. L. & W.	B. & A.	G. T. W.	C. N. R.	Monon.	B. & M.	Lima A-1	C. & N. W.	C. B. & Q.	A. T. & S. F.	Penna.	G. N.	N. P.	B. & M.	O. I. M. Co.
Type	4-8-4	4-8-4	4-6-4	4-6-2	2-8-2	2-8-2	2-8-4	2-8-4	2-8-4	2-10-4	2-10-4	2-10-0	2-8-8-2	2-8-8-4	0-8-0	0-8-0
Year built	1929	1927	1931	1929	1931	1929	1929	1926	1927	1928	1931	1922	1929	1929	1927	1927
Boiler pressure, lb.	250	250	240	215	265	220	240	240	240	250	300	250	240	250	250	225
Cyls., diam. and stroke, in.	27 x 30	27 x 32	25 x 28	25 x 28	24 x 30	27 x 32	28 x 30	28 x 30	28 x 30	31 x 32	30 x 34	30 x 32	4(28x32)	4(26x32)	23 x 28	23 x 28
Driving wheel diameter, in.	73	77	75	73	63	63	63	63	63	64	69	63	63	63	56	50
Tractive force, lb.	63700	64500	44800	40700	56200	69000	69400	69400	67200	90000	93000	80640	146000	139900	56800	55500
Valve gear, type	Walsch.	Walsch.	Baker	Walsch.	Baker	Walsch.	Baker	Baker	Walsch.	Baker	Walsch.	Walsch.	Walsch.	Walsch.	Baker	Baker
Piston valve diameter, in.	12	12	14	14	14	14	14	14	14	15	15	12	14	14	12	12
Maximum valve travel, in.	8½	9	9	8¼	8¾	8	8¾	8¾	8½	8½	9⅞	6	6¾	7⅛	8⅛	8¾
Steam lap, in.	1½	1½	2½	2	2½	2¼	2⅝	2⅞	2⅞	2½	3	2	1⅞	1⅞	2⅝	2⅝
Valve lead, in.	¼	⅜	1/16	Variable 1/16-¼	1/16	1/16	¼	¼	⅜	¼	¼	1/16	1/16	1/16	⅛	⅛
Exhaust clearance, in.	¼	0	⅛	⅛ Neg.	1/16 Neg.	1/16 Neg.	1/16	1/16	1/16	1/16 Neg.	⅛ Neg.	⅛ Neg.	0	0	⅛ Neg.	⅛ Neg.
Maximum cut-off, full gear, per cent	70-85	70-85	65	75	65	65	61	65	60	60	60	50	65	70	60	70
Valve travel, 25 per cent cut-off	3 11/16	4	6⅛	4 11/16	5 11/16	5 1/16	6 1/16	5 11/16	6	6 1/16	7¼	4 11/16	4½	4½	6⅛	5 1/16
Admission port opening, 25 per cent cut-off	11/16	½	1/16	11/16	11/16	11/16	11/16	11/16	1/16	11/16	5/16	11/16	5/16	5/16	1/16	11/16
Exhaust opening, max. 25 per cent cut-off	2 1/16	2	3 1/16	2 1/16	2 11/16	2 11/16	3 1/16	3 1/16	3 1/16	2 11/16	3½	2 1/16	2¼	2¼	3	2 11/16
Exhaust opening, end of stroke	2	1⅜	2 11/16	1 11/16 F. G. 2 1/16-25% C. O.	2⅝	2⅜	2 11/16	2¾	3	2 11/16	3⅛	2 1/16	2⅛	2⅛	2⅝	2⅜
Starting device	Reverse Lever Spring stop.	Reverse Lever Spring stop.	Franklin	P. N. Duplex	Franklin	Oaklamac	Franklin	Franklin	Piping Arrangement	Franklin	Chapman Lanhing	Franklin	None	None	Franklin	Franklin

Interlocking Spring Rigging Developed on the T. & P.

IN the conventional type of spring rigging now in use on practically all locomotives the strap hangers are bossed at the ends with drilled holes, which are sometimes bushed to receive the hanger pins. Other parts of the spring rigging such as the sword hangers, yoke hangers, equalizers and frame fillers, are similarly arranged with drilled bosses to receive the pins.

The stresses exerted on these parts are transmitted directly to the pins and the ends of the hangers, equalizers, etc., causing rapid wear and resulting in the elongation of the pin holes and worn pins. All railroads have given special attention to spring rigging in an effort to reduce wear. Special materials are used, pins and bushings are casehardened and special attention is given to lubrication. In spite of all of these precautions, spring-rigging parts are usually worn to such an extent as to require extensive repairs, if not complete renewal, each time the locomotive is given general repairs.

During the past five years, the mechanical department of the Texas & Pacific has been working on the development of an interlocking type driving spring rigging which is described in this article. This type of spring rigging is now in use on the following number and types of locomotives in service on the Texas & Pacific: 70 2-10-4 Texas type locomotives, 10 heavy Mountain type locomotives, eight-wheel switchers, six-wheel switchers and Santa Fe type locomotives.

Principal Features of Design

The principal feature of the interlocking type spring rigging is a flexible interlocking joint, a typical illustration of which is shown in Fig. 1, which provides a safer and more efficient bearing at the several joints in the rigging structure. It has been possible to increase the strength without additional weight, and it is said that such strength is maintained throughout the life of the parts at a minimum cost for maintenance. Interlocking joints have been provided at the ends of the hangers and the parts which they engage, and the design of these joints is such that the hanger pins are not subjected to the usual load encountered in the conventional type of rigging. In designing this spring rigging consideration has been given to the proper contour and offset of the bearing surfaces in order to reduce the stress and wear to a minimum.

Actually the use of hanger pins is not necessary since the interlocking feature prevents the separation of the parts when in tension. However, the pin is used in some cases as an additional protection should some condition arise which could possibly tend to roll or disengage a part from its mate. Such conditions are not liable to occur and in fact during an extensive experience it has never occurred.

Hangers Do Not Wear Frames

An examination of the detail drawings will reveal that where the pins are inserted a slotted hole is provided in one of the members at each joint in order to allow for a certain amount of wear on the bearing surfaces before any load can possibly come on the pin. If the wear on the bearing surfaces should progress to such an extent as to permit the pin to come under load, the connection as a whole becomes stronger, as the bearing value of the pin would then be added to the value of the bearing surfaces on the bosses. Likewise, as the wear progresses on the joint the strength

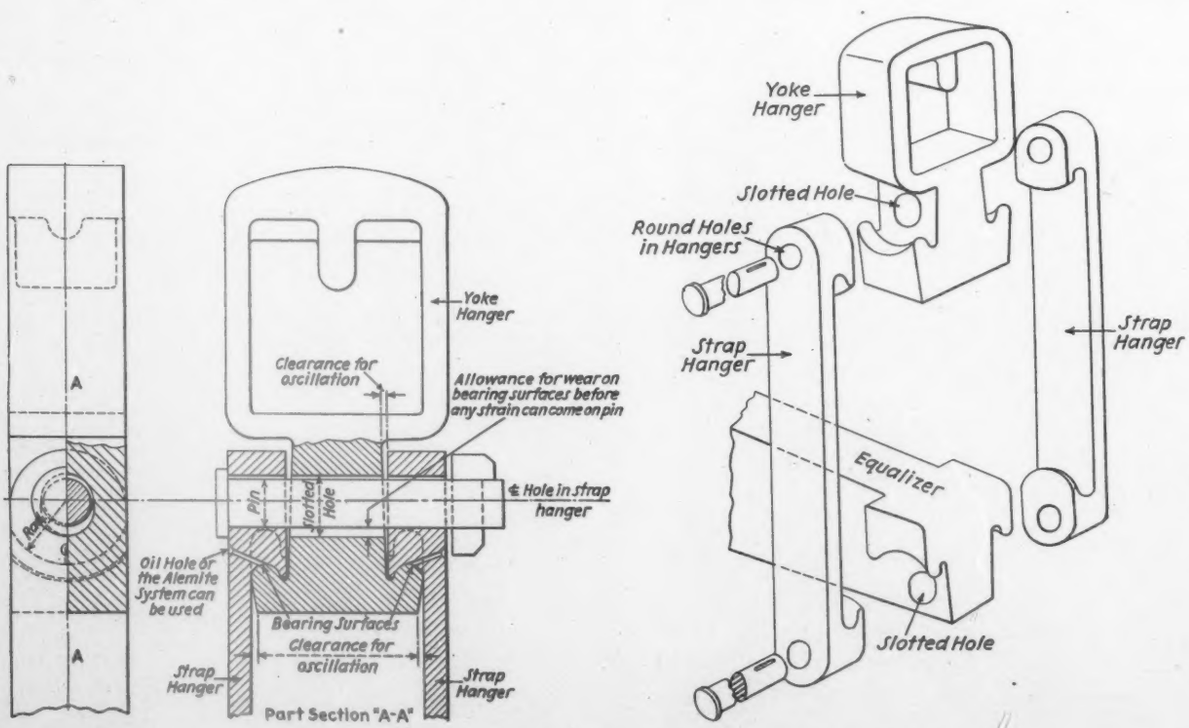


Fig. 1—Sectional view and details of the interlocking spring rigging joint

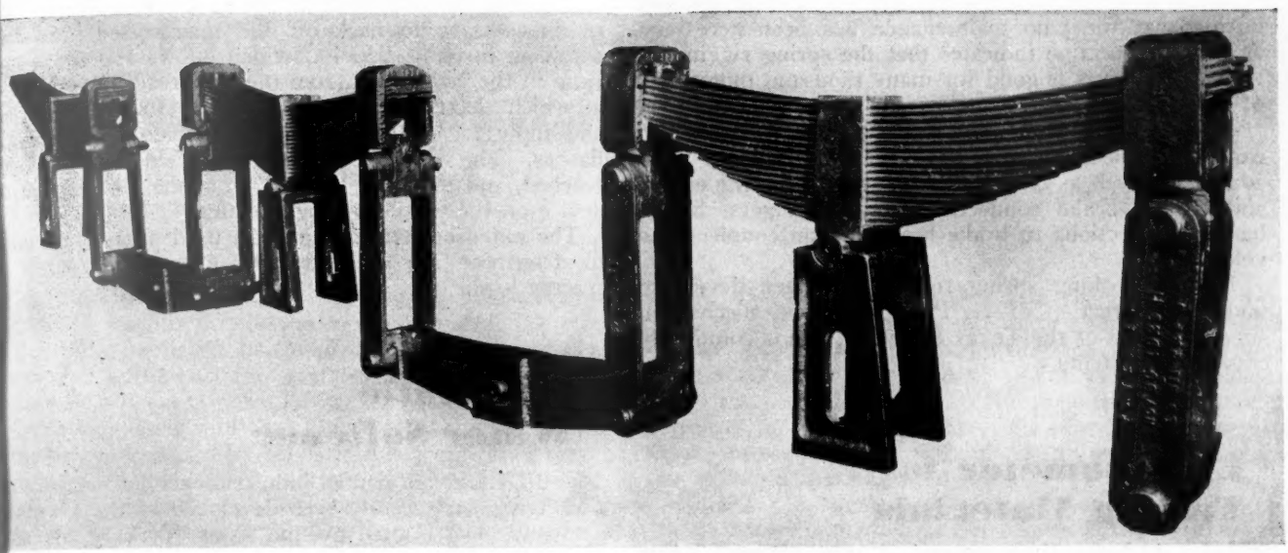


Fig. 2—An assembled view of the interlocking spring rigging

of each connection is not diminished throughout its remaining life. This feature alone is said to prevent many spring-rigging failures on the road.

Due to the flexibility of design both in a longitudinal and transverse direction all of the bearing surfaces of the entire rigging are in constant contact with one another, thereby reducing wear on the bearing surfaces and prolonging the life of the parts. Because of the fact that the various bearings are in continual contact, the entire rigging adjusts itself more rapidly to a position parallel with the locomotive frame. This keeps the hangers from coming in contact with the frame and prevents wear on the frames. This condition is also said to insure constant equalization of the weight of the locomotive, resulting in easier riding.

Fig. 3—Two views of hanger parts showing the locking lips

Should one of these hangers break while out on the road, its mate cannot become disengaged due to the interlocking feature of the lips. This would permit carrying the load until the locomotive reached a terminal, thus preventing a failure on the road.

Applications of the Device

As previously mentioned, the Texas & Pacific has equipped several different types of locomotives with this device. Some of these locomotives have operated over 400,000 miles with no maintenance cost at the engine

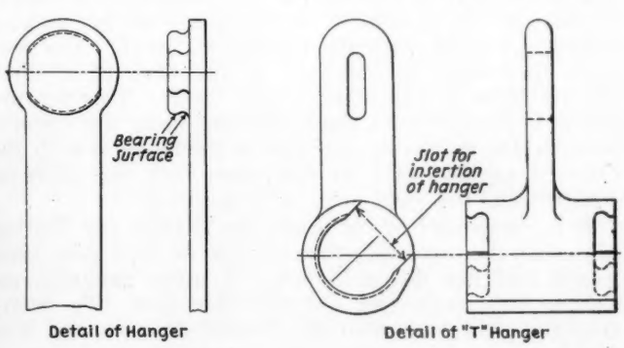


Fig. 4—An example of the interlocking joint where a pin is not used

terminal or at the periodical shopping during this mileage. In view of the condition of the spring rigging on these locomotives, it is difficult to predict what maximum life will be obtained. With the conventional type of spring rigging it would have been necessary to make repairs each time a locomotive was shopped for classified repairs at an average cost of from $60 to $125 per locomotive.

Many other practical designs of this type of spring rigging have been developed, one of which is shown in Fig. 4. The same principles apply to this design, but it has an additional feature whereby the hanger or other part is connected to its mate by means of a slot which it will be noted is on an angle. This is for the purpose of obtaining a full bearing area of the lips when in service position. After the part is inserted, it is given a part turn when it becomes locked and no pin is required. This particular design has been in service on some switching locomotives for over three years, and,

during that time, no maintenance has been necessary. A recent inspection indicates that the spring rigging on these locomotives is good for many thousand more miles of service.

There are many other locations on the locomotive or car where these features have been used to the same advantage, such as on the draw-bars between the engine and tender, brake connections, brake hangers, brake-hanger connections to brake head, and on couplers and yokes.

The interlocking spring rigging has been developed under the direction of A. P. Prendergast, mechanical superintendent of the Texas & Pacific, and is completely covered by patents.

Extensometer for Testing Materials

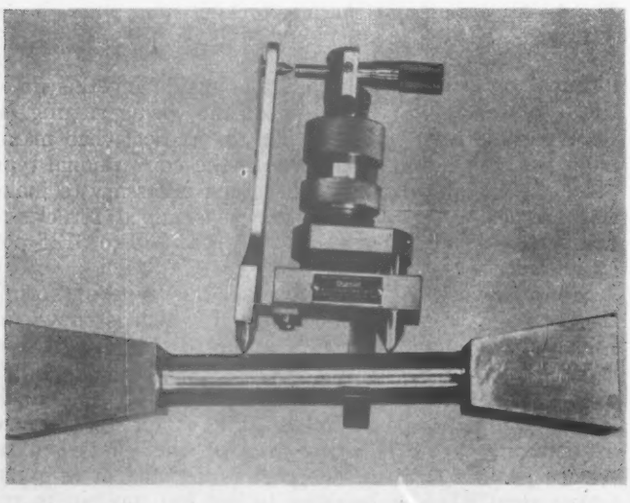
THE Oxweld extensometer, a new testing device which makes it possible to determine the yield point of specimens being tested in an Oxweld portable tensile testing machine, has been announced by The Linde Air Products Company, 30 East Forty-Second street, New York.

The sensitivity of the Oxweld extensometer is such that it will indicate the elongation in a standard A. S. T. M. test specimen occasioned by the heat of the human hand. Although highly sensitive, this precision instrument is simple, rugged, self-contained and self-compensating.

The two points of the Oxweld extensometer are clamped on the specimen to be tested in such a manner that the elongation between the two points during tension is multiplied in a ratio of 5-to-1 by a lever bar making electrical contact with the micrometer head. The moment of contact is indicated by the flash of a small electric light in the extensometer head. This feature makes it possible for a single operator using the Oxweld portable tensile testing machine in combination with the Oxweld extensometer to determine both the ultimate strength and the yield point of a specimen.

It is recognized by the American Society for Testing Materials that an elongation of 0.01 in. in a 2-in. gage length indicates the yield point of many materials including structural steel and malleable iron. To determine the yield point with the Oxweld extensometer it is only necessary to back off the micrometer head two complete turns (0.050 in., which allows for the 5-to-1 ratio in the lever bar) from the zero reading (the point at which electrical contact is broken) for the specimen and apply the load, increasing the tension until the light flashes. The flash indicates that the yield point has been reached, and this may be read from the load indicating device on the tensile testing machine.

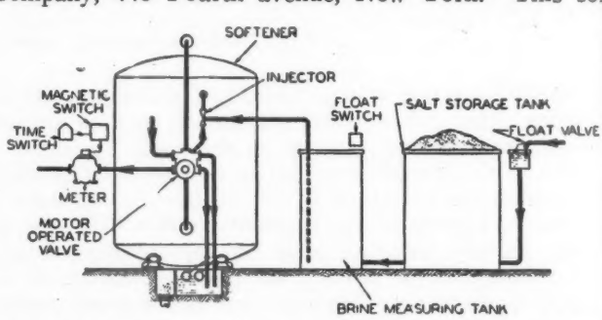
The extensometer may also be used as a strain gage to determine the elongation of a specimen under a specific load.



The Oxweld extensometer attached to a machined specimen ready to be tested in an Oxweld portable tensile testing machine

Automatic Water Softener

A FULLY automatic industrial zeolite water softener has recently been developed by the Permutit Company, 440 Fourth avenue, New York. This softener is said to eliminate the errors due to the human element and to conduct all of the operations of softening and regeneration with regularity and precision. By combination of a meter-operated switch and electric controls with a motor driven single valve, each operation of the water softener is conducted under precise control. Briefly, at the end of the softening run, the meter actuates the electrical controls which carry through the steps of: Cutting the softener out of operation; backwashing it for a regulated period so as to secure thorough cleansing; admitting a carefully regulated amount of saturated salt brine so as to assure thorough regeneration without wastage of salt; rinsing out the hardness salts to waste with the minimum amount of rinse water; and throwing the softener back into service thus placing it again under control of the meter, which governs the volume of water to be softened during the softening run and initiates the start of the next regenerating cycle.



Diagramatic arrangement of the Permutit water softener

Not only may the new models be had in the full automatic type but it is also possible to apply the automatic control to existent downflow softeners and thus convert them from manual to fully automatic operation.

A CLUB CAR AS IS A CLUB CAR.—The club car which is now being operated regularly between New York and Miami, Fla., by the Atlantic Coast Line must top all existing records for unique railroad train equipment. The car is said to represent the ideas of Henry L. Doherty, president of the Florida Year-Round Club, as to the sort of railroad equipment that would be able to compete suuccessfully with the recreational facilities offered by steamships on the New York-Florida run. The car has a dance floor and a three-piece orchestra to go with it, a gymnasium, a locker and shower room, a wading pool and a screen for motion pictures. If the Atlantic Coast Line can arrange to keep the car pumped full of cold, wet, salt air, the illusion of coastwise steamship travel will be complete.

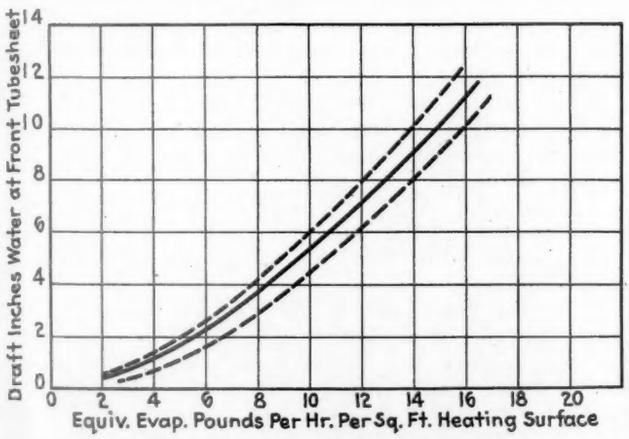
Relation Between Draft and Evaporation

By E. L. Schellens*

A NUMBER of useful thoughts have been developed in various articles on locomotive drafting which have been published in the *Railway Mechanical Engineer* during the past few years. There is one important problem, however, which the writer has never seen completely discussed, and that is the relation between draft and evaporation. The fundamental proposition may be divided into two parts and stated as follows: (1) For a boiler† of given characteristics and given draft efficiency there is only one correct exhaust-tip area for maximum boiler efficiency; (2) for a boiler of given characteristics any increase in draft efficiency must be accompanied by a corresponding change in exhaust tip area to maintain maximum boiler efficiency.

The solid line in the chart represents a typical curve showing the relation of net draft at the front tube sheet to equivalent evaporation in pounds per hour per square foot of heating surface. The increasing slope of the curve is due to decreasing boiler efficiency as the evaporation rate goes up. We will refer to this later. It is assumed the engine is properly drafted over the entire evaporative range; that is, for maximum boiler efficiency.

Case 1.—Suppose that we maintain the same ash-pan openings, grate and fire conditions, arch, flue area and length and identical smokebox construction. Also suppose we now increase the tip area without changing the design of the tip. The result will be as shown on the lower dotted curve of the chart; namely, less draft at each point of evaporation. However, the engine will be a poor steamer, the symptoms of which will be lagging boiler pressure and dense black smoke at all operating rates. There is, of course, a limit to which we can go in this direction without disturbing the satisfactory steaming qualities of the engine.



Typical curve (solid line) showing the relation of net draft to equivalent evaporation

Case 2.—Assume the same conditions as in Case 1, except that the nozzle area is decreased below the original value. The result is shown on the upper dotted curve of the chart. In this case the engine is over-drafted. The symptoms are entire absence of black smoke, except when overcrowding the fire. Also very free steaming will be evident and it will be possible to open the pops at any time. The pops will be kept from opening by starving the fire. In other words, there is more excess air going through the grates than necessary to maintain draft equilibrium.

Case 3.—Assume, now, the same conditions started out with; namely, to produce the results shown on the full-line curve, except that the draft efficiency has been increased by any one of the following expedients:

1—Increase in ash-pan openings.
2—Increase in grate openings.
3—More favorable gas-area ratio through the tubes and flues.
4—Reduction in baffling restrictions in the front end.
5—Improvement in nozzle and stack design.

We now have the conditions shown on the upper dotted curve; namely, the engine is over-drafted. To correct this condition it will be necessary to enlarge the tip area.

Increasing the Draft Does Not Increase Horsepower Output

There appears to be a widespread belief that it is possible to increase cylinder horsepower by merely increasing the draft, by means of reducing the tip area, or improving draft efficiency without enlarging the tip. This is not correct, since in doing so the equilibrium between draft and evaporation is upset on the over-draft side. While it is true that cylinder horsepower can be increased with any given tip by merely lengthening the cut-off at a given speed, the practical limit is reached through prohibitive back pressures.

The logical approach to higher horsepower through the draft lies in an improvement in draft efficiency and an increase in tip area, which has a two-fold result:

1—Less back pressure and, therefore, more cylinder horsepower for the same draft.
2—Higher evaporative ratings within reasonable limits of back pressure.

It is important to keep in mind that the mere attainment of higher draft efficiency does not fulfill the objective of greater overall efficiency unless such higher draft efficiency is accompanied by a corresponding reduction in back pressure through an increase of tip area. Otherwise the conditions are as stated in Case 3 and over-drafting results.

The question now arises, if it is true that there is a definite equilibrium between draft and evaporation and if one size tip and only one is correct for any locomotive of given design, how is this affected by various evaporative rates along the entire range of operation?

The increasing slope of the draft-evaporation curve has been referred to before as being due to decreasing boiler efficiency as the evaporation rate is increased. It appears to be purely a matter of luck, that from the earliest days of locomotive development the change in boiler efficiency at increasing rates of evaporation bears a remarkably close relation to the change in draft ef-

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† The word "boiler" in this sense includes the complete steam generating unit with grates, ashpan, furnace, superheater and feedwater heater.

ficiency at increasing rates of evaporation. It is this coincidence which accounts for the fact that it is generally true that if a locomotive is properly drafted at one evaporative rate it is properly drafted at all rates.

Effect of Front-End Arrangement

There are certain types of front-end arrangement where the above is not true, as the draft efficiency characteristic does not parallel that of the boiler. In such a case, for example, a locomotive will steam well on a heavy train but falls down for steam on a light train. In other special cases the reverse may be true.

In the design of any new type of front end this important relation should be kept in mind; that is, the draft efficiency over the operating range should parallel the boiler efficiency as nearly as possible.

It is of special importance to keep these relationships in mind in connection with smoke-prevention problems. In order to reduce or eliminate smoke, the locomotive should always be slightly over-drafted, although, from an efficiency standpoint, great care should be taken not to go too far in this direction. Other operating advantages, such as free steaming and proper burning of the fuel bed, appear to favor a slightly over-drafted condition. Unfortunately, it is not possible always to realize this condition with the conventional designs of front end, due to excessive back pressure. For a satisfactory solution of the smoke problem, we must look to an improvement in overall draft efficiency, permitting adequate draft at reasonable back pressures.

For increase in draft efficiency we must look not only to the stack and nozzle design but to proper grate design, and tube and flue proportions. Elimination of baffle restrictions in the front end is perhaps of even greater importance. The importance of restrictive influences in the front end appears to have been overlooked for many years. However, it has been clearly demonstrated within the last year that it is possible to omit entirely all restrictions, thus conserving from 20 to 50 per cent of the total draft energy required to support the same combustion conditions. This 20 to 50 per cent of the total draft energy is usually wasted in restricting and throttling the gases in order to perform the mechanical work of grinding the cinders for their passage through the netting, which is an inefficient method of accomplishing this result.

In connection with grate design, it may be stated that from a draft standpoint only, the larger the effective opening the better. However, from a combustion standpoint this rule may be carried too far, as when the gas velocities through the fuel bed are too low at low ratings, it is impossible with certain types of coal to burn a good fire. For this reason, some roads have had better success by deliberately restricting grate area, even though this is done at the expense of draft efficiency. This is an operating problem which requires the closest attention and is all the more difficult since there appears to be no fixed rule to govern all conditions.

One Hundred Years Ago This Month

February 2, 1833.—A description of Ericsson's steam engine and water mill, which was reprinted from the London Mechanics Magazine, appeared in this issue of the *Journal*. The introductory paragraph of the article has the following to say: "Owing to a variety of causes, all well ascertained by long practice, a reciprocating engine cannot be made to work to advantage at more than a moderate rate of speed; it becomes therefore necessary to expose the piston to a great force (for that force multiplied by the speed constitutes the power), and, as a necessary consequence, all the parts that have to communicate this great force, as well as the frame work that carries those various moving parts, must be made strong in proportion. Hence it follows, as a general rule, that the bulk and weight of any engine of a given power, worked by steam or given force, must depend on the speed of the piston, that is, the speed of that surface which the steam is made to propel. This truth forms the basis of the construction of the very remarkable engine which we have now to bring under the notice of our readers."

February 9, 1833.—This issue of the *Journal* contained an article reprinted from the Baltimore Gazette which reported the progress being made in England in operating steam carriages over turnpike roads. The writer points out that, considering the success of the locomotive steam engine upon railways, the application of the steam engine to conveyance upon land as well as upon water was certainly assured.

This issue also contains a poem entitled "The Lay of the Locomotive," by Henry J. Finn, the first stanza of which reads as follows:

"He tells you flatly what his mind is."—*Shakespeare.*

With the swiftness of the swallow, and the color of the crow,
I am *train'd* up, like a child, in the way that I should go;
From the time that I had motion, from the first day to the *last* day,
Alas! I've been *consuming*, for each day has been a *fast*-day.

February 16, 1833.—NEW PATENTS.—George Frederick Muntz, of Birmingham (England), metal roller, for an improved manufacture of metal plates for sheathing the bottom of ships and other vessels. Six months; October 22, 1832.

Henry Scrivener, of New Broad street, London, gentleman, for a certain improvement or improvements in the construction of iron railways. Two months; November 3, 1832.

Jacob Perkins, of Fleet street, London, engineer, for an improvement in preserving copper in certain cases from the oxidation caused by heat. Six months; November 20, 1832.

February 23, 1833.—The annual report of the Canal Commissioners of the State of New York was published in this issue. The first two paragraphs of the report read as follows:

"The day fixed upon by the Commissioners for the commencement of navigation upon the Erie, Champlain, Oswego, Cayuga and Seneca Canals was the twentieth of April last; but in consequence of the injury done to canals by the spring floods, it was found to be impracticable to have every part of them navigable before the twenty-fifth.

"The canals were frozen, so as to prevent navigation, about the twentieth of December. The navigation was interrupted by ice at some places on the canals before that time; but not so as to prevent boats from reaching their places of destination. Most of the persons engaged in navigating the canals had discontinued running their boats before the commencement of freezing weather; and but few boats were actually engaged in the transportation of property at the time the canals closed."

THE USEFUL BOX CAR.—The brighter minds of the country are thinking up all sorts of ways to make use of discarded railway-box cars. One favorite expedient, we understand, is the sale of the box cars to farmers who want to use them as corn cribs, sheds, etc. Cars 40 ft. long, which will hold 900 bu. of corn, are selling at $10 each.

EDITORIALS

Efficiency and Economy

For a number of years the mechanical department of an eastern railroad has followed the practice of adopting each year a slogan and a list of five or more objectives. The slogans adopted for the past three years of business depression and reduced earnings were: 1930, "Quality and Quantity"; 1931, "Think—Analyze—Act"; for 1932, the slogan was "Organize—Deputize—Supervise". The slogan adopted for 1933 is "Efficiency—Economy".

Considered in the light of the developments of the past three years, these slogans have met the situation created in a most effective way. There is no doubt but that the railroads will have to go further in both efficiency and economy. There is much that can still be done to render more efficient service. When considering further economies, it is well to find out how such economies will effect efficiency. Efficiency may suffer by ill-advised economies.

The following objectives have been adopted by the road in question for this year: Cost consciousness, fifty per cent reduction in Federal defects, twenty-five per cent reduction in engine failures, fifty per cent in personal injuries, and cleanliness and order, with special attention to the back yard.

That is where economy can well begin.

Robbing Peter To Pay Paul

The necessity for the railroads to institute drastic economies because of the business depression has tended to revive many of the wasteful practices which had largely been eliminated in recent years. This point is brought up by a correspondent whose letter appears on "The Reader's Page" in this issue. The writer, in discussing the waste of fuel at engine terminals, gives as the reason the shortage of labor. If the man responsible for locomotives waiting on the ready track has a lot of other work staring him in the face, he is going to put in a heavy fire on each visit to a locomotive and also see that the boiler has plenty of water so that he will not have to come around so often.

Of the average dollar of operating revenues received by the railways in 1930, 44.6 cents was spent for labor; 24.5 cents for materials and supplies, and 5.4 cents for locomotive fuel. As to be expected, the labor expense of operating a railroad has stood out prominently from among other classes of operating expenses and has received close attention in effecting economies.

Without considering the ultra important social problems created by laying men off, some roads have gone so far in reducing forces that the economies obtained have been like "robbing Peter to pay Paul." It is indeed a sad situation to see men who want to work out of a job and those who have jobs burdened with more work than they can handle efficiently or, for that matter, even well.

One road reported exactly 50 per cent of its engine failures during one month of this winter as being due to poor inspection or to poor workmanship. The larger number of these failures occurred on passenger locomotives. Quite a number occurred in through-freight service. In either case, the train delays did not do the railroad any good and may have helped to divert more business to competitive forms of transportation.

Plan Now for Business Revival

It is characteristic of humankind to form its vision of the future by a short look backward. At the height of the speculative boom of 1929 the commonly accepted vision of the future was based on a forward projection of the trend of events we had experienced during the immediate past. Furthermore, while that trend was of limited duration in the past, its future duration was believed to be limitless. As 1933 gets under way, we look back over a period of three years of declining business activity and, in far too many cases, our thinking is colored by the gloomy picture of a future made up of the present extended to eternity.

Few of us have a sufficiently clear understanding and quantitative knowledge of the processes involved in these economic swings to say with assurance just when the trend of business activity will be reversed. The probability is that the change will not be long delayed, if, indeed, it has not already occurred. Be that as it may, it is time for railway officers to cease to magnify a three-year depression into a period of eternal gloom and to begin to plan sanely for a future of renewed business and industrial activity.

One field in which there is great need of planning on a new basis is that of motive power. The last real attention this matter received from railway executives generally on a nation-wide basis was in 1923 and 1924 when the heavy programs of rehabilitation and modernization of existing locomotives were inaugurated, activity thus stimulated declining steadily during the succeeding years. From 4,360 locomotives installed in 1923, the number had dropped below 2,000 by 1925 and reached a low point of 1,017 in 1928, rising to 1,229 in 1929. The total number of installations during the seven years ending with 1929 was about 14,400. During this same period, however, only approximately 8,000 new locomotives were received from the builders. More than a third of the locomotives installed must be accounted for as old locomotives which had been retired from the accounts and reinstated following partial modernization.

During this same period occurred the culmination of a series of developments which have made obsolete locomotives built more than eight or ten years ago. The combination of the large firebox, the type E superheater, and the four-wheel trailing truck has converted the locomotive from a machine rated by its starting tractive force to one which is rated by its horsepower capacity. But the relatively small growth in traffic during the years following the close of the war as compared with the rate which had long prevailed prior to that time, and a growing intensity of utilization, had combined to remove the need for additional aggregate motive power capacity. During the six years from 1927 to 1932, inclusive, locomotive orders averaged only a few over 500 and, except for 1929, when over 1,200 locomotives were ordered, the largest number of orders

placed in any year was less than 750. As the result of the depression, orders declined from 440 in 1930 to 235 in 1931 and practically none last year.

And yet the experience of those roads fortunate enough to have gone into the depression with recently purchased modern locomotives has clearly demonstrated the economic fallacy of continuing to own aged and out-moded locomotives. But with a relatively stable maximum volume of traffic in prospect for which the railroads have already provided ample capacity, a policy of purchases and retirements must be adopted which will control obsolescence if the steam railway is not to become obsolete as a whole. Advantage must be taken of the developments in the art which have steadily been accumulating and which will undoubtedly continue to be made in the future.

The relative business inactivity of the past three years has been used by many industries to carry out complete redesign of products preparatory to the keen competition which may be expected as the demand begins to increase. The railroads, probably more than any large industry in the country, need to be preparing for the new competitive situation which has so clearly come to light as the result of the depression. One of the conditions which this situation demands is the utmost in operating efficiency and reliability of service. The railroad management which does not have well considered plans for relieving its motive-power inventory of the tremendous accumulation of obsolescence which has taken place during the past seven or eight years will find itself pushed into ill-considered hysterical activity as its volume of traffic begins to build up.

Economies?

In these times of depression when our household appliances need fixing, many of us have found it expedient to get out a hammer, a wrench, the pliers, some wire, or the adhesive tape and get our appliance functioning again. Some of these jobs are of so simple and obvious a nature that almost any householder, with a common understanding of the functioning of the equipment or appliance, can do a fairly satisfactory job. Other repairs which cannot be done properly by the average householder can still be done effectively enough to meet an emergency. If such repairs are of poor quality, they have cost nothing but a little leisure time—and who puts a commercial value on such leisure hours?

In these times innumerable parallel situations may be found with respect to the maintenance of the specialized devices on cars and locomotives. Some of these repairs can properly be done by railway employees in railway shops; in fact, they form a part of the every-day work of these men. When old parts have to be replaced on many of these devices, however, new ones never can be properly produced by railway employees in railway shops. Nevertheless they are being produced, after a fashion, and can be utilized in an emergency. But, unlike the jobs of poor quality done by the householder to save a purchase, the time expended in producing materials and parts of poor quality in the railroad shop is not leisure time and it has to be paid for in dollars by the railroad. In these cases the dollars saved from material purchases are not dollars saved to the treasury of the railway. Where reliability of service is paramount, as it is in the case of most equipment specialties, the inferior quality of the make-shift product is a factor which, although it may be difficult to evaluate, weighs heavily in favor of the commercial product, made of properly selected materials and under controlled conditions, irrespective of its price.

All manufacturing operations in the railway shop, and especially those producing repair parts for highly developed car and locomotive specialties, should be subjected to the closest scrutiny, for two purposes: First, to be sure that apparent economies effected by curtailment in material purchases are not actually wasting the resources of the railways, and, second, to weed out the jobs which are jeopardizing the reliability of railway equipment.

Something To Think About

Railway operating and mechanical-department officers unquestionably are confronted with a fertile field for investigation and appropriate action when they consider the performance of gas-electric rail cars now in service on American railroads. According to a news bulletin recently released by the General Electric Company, the 12 gas-electric rail cars, for example, placed in service on the Texas & Louisiana lines of the Southern Pacific during 1929 and 1930, in conjunction with a number of trailers, replaced steam trains on a number of lines, covering more than 2,000,000 train-miles during 1930-1931 and earning a net return on the investment of slightly over 100 per cent in those two years of operation.

A condensed table of operating results, including because of keen interest in the details of this subject, shows, among other things, the high degree of availability of the motor cars, which increased from 92.1 per cent in 1929 to 96.2 per cent in 1931. This performance figure is usually interpreted to mean the percentage of the regular assigned mileage which the equipment was in condition to make from a mechanical and electrical standpoint, and a record of 96.2 per cent is a striking tribute to the reliability of this particular equipment. It is also interesting to note that the repair costs for gas-electric rail equipment increased but slightly in the three years under consideration, being only 3.8 cents per motor-train mile in 1931, the net return on the investment in that year interest at 6 per cent for both motor and trailer equipment, decreased to slightly over 37 cents per motor-train mile in 1931, the net return on the investment in that year being 55.2 per cent.

Condensed Operating Results With 12 Gas-Electric Rail Cars

	1929	1930	1931
Number of gas-electric motor cars	44	12	12
Motor-train-miles per motor car per day	248	257	257
Total motor-train mileage	234,370	989,498	1,060,742
Total trailer mileage	236,523	1,268,211	1,242,336
Availability of motor cars, per cent	92.1	95.3	96.2
Repair cost for motor equipment per motor-train-mile	$0.034	$0.031	$0.038
Operating cost per motor-train-mile, including depreciation and interest at 6 per cent (trailers included)	$0.375	$0.3896	$0.3719
Annual saving over comparable steam-train service	$77,225	$307,140	$348,029
Total motor-car investment	$195,796	$631,038	$631,038
Net return on investment, per cent	39.4	48.7	55.2

Six of the cars referred to are equipped with 400-hp. engines and six with 300-hp. engines. In addition to these modern cars, the Southern Pacific is operating, in this same district, two of the older gas-electric cars, built by the General Electric Company in 1912. These cars have been in almost continuous service since their installation and, during 1931, made the following record:

Motor-train miles, 114,715; trailer miles, 114,651; availability, 95.9 per cent; repair cost for motor equipment, per mile, 3.7 cents; operation cost, including interest and depreciation on motor equipment and trailers, per mile, 44.41 cents. These figures bear eloquent testimony to the effectiveness of the gas-electric principle as applied to rail equipment, even that which was placed in service a decade before the development of modern motor cars began.

What Does Technocracy Lead To?

There is certainly little need to record here the fact that this thing called technocracy has started a lot of people talking. It has been said that an argument is exercise for the tongue while a discussion is exercise for the brain. Because it is radical in its nature and has touched a receptive spot in the public fancy technocracy has indeed been the cause of a great deal of argument and, fortunately, some real sound discussion. Out of one such discussion which took place recently in a mid-western city among some well-known engineers and technical educators came the conclusion that in this country we have reached the end of an era in which our major efforts have been devoted to the problems of increasing production and that we are about to enter an era in which economics, human relationships, social problems and the problems of the distribution of the fruits of production will be paramount. More than this, these engineers frankly admitted, to themselves if you will, that by virtue of his very training the engineer is not equipped to deal with such problems as we are about to be faced with and that where technical education has occupied the center of the stage for many years the training schools of the future must turn out men the scope of whose education has been so broadened as to include a consideration of these newer factors in our national life. Does this check with the theories of the technocrats?

Technocracy, in its consideration of the problems of mankind, has not neglected the railroads. In fact, the railroads have been used as an example of what is taking place to deprive men of their opportunities to work. It was pointed out, using one well-known railroad as typical, that the tremendous increase in the efficiency of modern motive power has made it possible, since 1920, to haul 13 times the load that was then possible with, as one writer figured it out, a theoretical wiping out of 99 out of 100 job opportunities that existed for railroad men in train service 13 years ago. At this rate, if we follow the reasoning of technocracy, it will not be long before we will be hauling the freight tonnage of this nation with practically no men at all.

It cannot be denied that modern motive power has made it possible greatly to increase the capacity of our transportation systems and that there is a gradually contracting circle of opportunity for men in train service. But how about the men "behind the line"? Do there not exist opportunities in railroad service today for craftsmen of a type that did not exist 20 years ago? Of course, in answering this question it must be taken into consideration that railroad employment is at low ebb today because traffic is at low ebb and one of these factors is inseparably related to the other.

Figures for 1916, for instance, as compared with 1930 will indicate that the average number of revenue tons of freight hauled one mile by Class I railroads for each employee in their service (embracing all branches of service) increased slightly less than 50 per cent. There is considerable difference between this figure and that of 1,300 per cent. The principal difference is that it takes into consideration all branches of railroad service.

The "findings" of technocracy seem to have provided one of the best substantiations of modern times of the old saying that "given enough statistics one can prove anything." It all depends upon which side you are on. However, to contend that technocracy serves no useful purpose is to be guilty of prejudice or shortsightedness. It has started millions of people talking and, fortunately, has caused other thousands to do some hard and constructive thinking. Real thinking by the right kind of people, properly co-ordinated and followed by constructive, concerted action, will go a long way toward the solution of our present difficulties and their future recurrence.

NEW BOOKS

PETROLEUM PRODUCTS AND LUBRICANTS. *Published by the American Society for Testing Materials, 1315 Spruce street, Philadelphia, Pa. 280 pages. Heavy paper binding. Price, $1.25.*

This publication brings together in convenient form the various A.S.T.M. standard test methods for petroleum and its products and the 1932 Report of Committee D-2 on Petroleum Products and Lubricants. There are 48 test methods given, 33 having been accepted as standards and 15 as tentative standards. Revisions accepted at the June, 1932, meeting, which involve test methods for flash and fire points with the open cup, the test for cloud and pour points, and test for viscosity, are given in their latest form. The standard test method for distillation of natural gasoline just adopted by the society, is given, as well as color tests for lubricating oils and for petrolatum with A.S.T.M. Union Colorimeter, test for gravity of petroleum products with the hydrometer, and test for vapor pressure of natural gasoline (Reid method), all of which were revised this year. Other standard tests cover the determination of autogenous ignition temperatures; determination of bitumen; burning quality of kerosene oils and of mineral seal oils; carbon residue; sulphur; specific gravity; color test of refined petroleum by Saybolt chromometer; dilution of crankcase oils; distillation of crude petroleum, gasoline, naphtha, etc.; ductility of bituminous materials; flash point by Pensky-Martens tester, float test for bituminous materials, and test procedures for properties of gas oils and the analyses of greases. Also given in their entirety are tests for electrical insulating oils; melting point of waxes and of petrolatum; penetration of bituminous materials, greases and petrolatum; saponification number; thermal value of fuel oil; and water in petroleum products and other bituminous materials. A volume correction table for petroleum oils is included, also a facsimile of the recently published A.S.T.M. viscosity-temperature chart, with directions and suggestions for its use. The 1932 Report of Committee D-2 includes a statement on cloud and pour test with an appended paper, "A Microscopic Study of Certain Oils which Show the Phenomenon of High- and Low-Pour Points"; the report of the Section on Gum in Gasoline, with proposed methods for determining gum content; a suggested test for the determination of knock characteristics of motor fuels, and a report on fuel oils.

THE READER'S PAGE

Locomotive Piping Practice

To the Editor:

I have read with much interest your editorial on Reduced Locomotive Failures in the January, 1933, issue of the *Railway Mechanical Engineer,* and also the article on Locomotive Pipe Clamping referred to in the editorial. It is hard for me to believe that the development of the improved piping installation and clamping arrangement is entirely responsible for the improved condition. I have in mind such things as threads of pipes put on at the wrong angle, pipes sprung in place to fit clamps, unusual stress placed on pipe threads by clamping or supporting of apparatus. These things, while not shown in any layout, are only a few which might be mentioned and all within the province of proper inspection.

In the article starting on page 28 you portray a lack of proper inspection throughout and, if such is again the case, it is only a question of time when the defects will repeat themselves. The designer's work is often wasted if it is not so arranged that proper and efficient inspection sees his plan through.

A Reader.

Stop That Waste!

To the Editor:

Compressed air is put to many uses in the modern railroad-repair shop and pipes extend in almost every direction throughout the shop and transportation yards. The uninformed think that this type of power is inexpensive inasmuch as it is taken directly from the atmosphere. However, they fail to realize that although the air we breathe is free, it costs money to compress it. For that reason, small air leaks are frequently regarded as unimportant. It is a fact, however, that the cost of compressing 1,000 cu. ft. of air is 15 cents. With this figure as a basis, the leakage from a hole ¼ in. in diameter will cost the company more than $8,000 per year.

Many employees around an enginehouse seem to think that it is their duty with respect to locomotives standing on the ready track to keep the steam pressure near to the popping point at all times. This is still occurring regardless of the efforts to save fuel that are being made by fuel associations, smoke engineers and others. Shortage of labor at many engine terminals has tended to revive many wasteful practices. Ordinarily a locomotive can be easily moved on 50 per cent of its rated steam pressure. As a general rule, there is sufficient distance to be traveled in hostling to build the fire up and obtain the necessary working pressure. There are many enginehouse foremen who could save the company a lot of money if they checked the amount of coal being burned by the locomotive standing on the outbound track.

A paper was presented before a meeting of supervisors last fall by a man who was responsible for a considerable portion of the steam-heat equipment on his railroad. One of the points he brought out in his paper was that a great many steam-trap diaphragms are scrapped when the fault is actually in the valve seat or adjusting screw. If the diaphragms are made to expand within certain limits, he said, the traps may be set cold and given a positive bench test in the shop. I happened to meet the author of this paper a few months later and he told me that since presenting that paper he had been given the opportunity to test several thousand diaphragms that had been sent to the scrap heap. He discovered that approximately 90 per cent of them were still serviceable. The reclaimed diaphragms, he informed me, carried his road through the entire winter.

W. L. McGowan.

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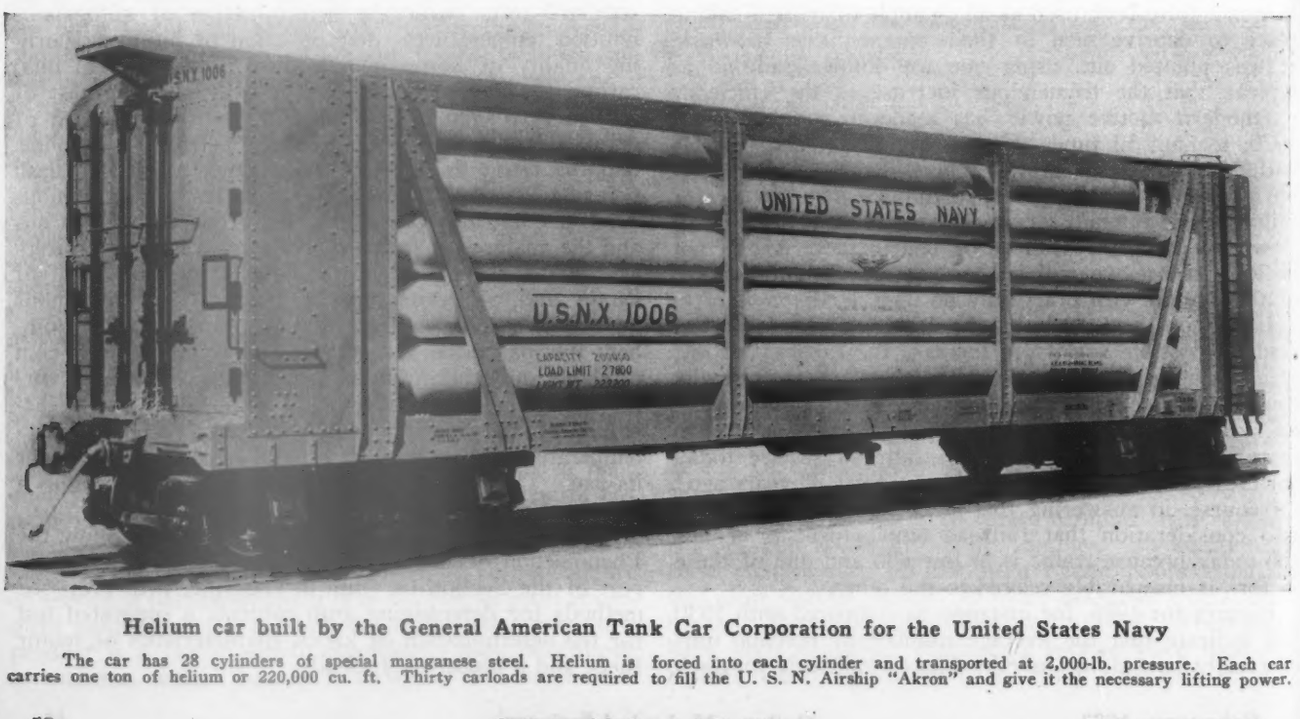


Helium car built by the General American Tank Car Corporation for the United States Navy

The car has 28 cylinders of special manganese steel. Helium is forced into each cylinder and transported at 2,000-lb. pressure. Each car carries one ton of helium or 220,000 cu. ft. Thirty carloads are required to fill the U. S. N. Airship "Akron" and give it the necessary lifting power.

With the Car Foremen and Inspectors

Proper Care Of Car Journals

By Car Foreman

A visit to car-wheel shops and car-repair tracks in different parts of the country reveals that there are still preventable abuses to car-wheel journals in the careless handling of wheels and axles. The A. R. A. Lubrication Committee has emphasized the importance of giving car-wheel journals better care. Much intensive work has also been done along these same lines by car-department men. Yet, despite all this, there are still to be found instances indicating an utter disregard of plain mechanical principles. There are the men who use wood or steel bars, or some such device, on the journal in handling wheels, because they do not wish to take the time to obtain proper tools. Such a practice indicates above all else laxness in supervision. The most inexcusable abuses are found where old and obsolete practices have been permitted to be continued and the men have not been awakened to a full realization of the importance of the highest possible maintenance attention to car journals as a very important factor in the fight to minimize hot boxes. It seems impossible to impress upon some men that a car-wheel journal is not a coarse, gross piece of machinery, one that may be abused with impunity. Until this fact is realized, we shall continue to have hot boxes, due to abused journals.

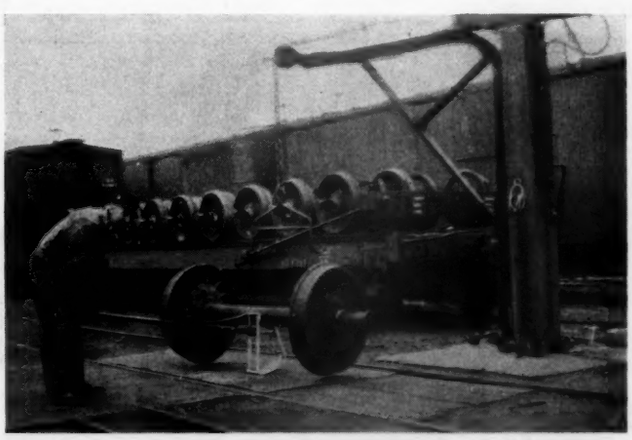
Type of sheet-metal guard used in protecting journals during shop and rip-track handling

The glazed polish on a car journal should be treated with as much care and respect as is the polish on your car or on a piece of nice furniture, and nothing should be done to it to injure or mar it in any way. The palm of the hand is about as hard and rough a substance as should be permitted to come in contact with this journal polish.

How Car Journals Are Damaged

There are many opportunities for damaging the journal from the time the car with the bad-order wheel is placed on the rip track until this axle is again applied to a car. The first likely damage will be a long scratch due to mechanics dragging the journal box on the surface of the journal when removing the box; or maybe they will spin the box upside down with the dust-guard partition scoring the journal. With the side frame and box integral, it is difficult to remove the side frame without seriously scratching the journal, unless a good shield is applied over the journal prior to the dismantling of the truck. These same abuses are likely to occur, in the reverse order, when a truck is re-assembled. In that case, however, they are much more dangerous, as the scratches will go undetected and cause a hot box, whereas the scratch made in removal can and should be detected and remedied prior to this axle's being returned to service stock. The use of such shields should be made mandatory. Applying protective shields to the journals prior to the removal and application of the ordinary journal box is also good practice.

The old-fashioned wheel stick or crutch, which engages the surface of the journal, is still widely used in the handling of mounted wheels. This device should be banned from all rip tracks and wheel shops. Many a hot box may be traced back to journal abrasions made by cinders or other gritty matter on the wheel stick or on the journal when wheels were so handled. Dragging the edge of the finger nail across scratches that may appear to be insignificant reveals the fact that they are serious. Having the man guilty of abuses to journals examine such scratches through a microscope is one way of forcefully impressing him with their seriousness. The rough edges of these scratches dig into the soft lead lining of the journal bearing, thereby reducing the effective bearing area, causing excessive friction and leading to a hot box. This is particularly bad at such a time as we already have a restricted bearing area, due to the application of the new bearing. It takes considerable time for these roughened scratch edges in the steel to wear down to a comparatively smooth surface and, until that does occur, such scratches remain a menace to the safe and proper running of the journal. What



Light and efficient mounted wheel-turning device of welded tubular construction

has been said regarding the wheel stick applies equally or more so to any other device used in contact with the face of the journal for handling wheels. Among these may be enumerated jack bars, steel bars, pieces of pipe, sticks of timber, chains, hoist, tongs, etc.

A modified form of the wheel stick so constructed that it engages the outside collar without contacting the surface of the journal, is effective if carefully used. The collar stick, as ordinarily used, however, is far from being a perfect tool. Unless correctly grounded at the start of the turn, it becomes unbalanced before the turn is completed, and will either slip off, or worse, slip over onto the face of the journal. This type of stick can be made very efficient for turn-handling wheels in wheel shops and on storage and service tracks, by equipping regular turning corners with a plate having cast in its top face a series of depressions, in a line splitting the angle of the two tracks; that is, equidistant from each rail, spaced to suit journal lengths, and each depression marked with the journal length. A rounded knob on the end of the wheel stick is set into the depression in the plate, corresponding to the length of the journal on the wheels being handled. This assures a correct position of the stick, the turned wheel being lined correctly for the other track, and with no side tilting or slipping of the stick that might permit it to touch the face of the journal.

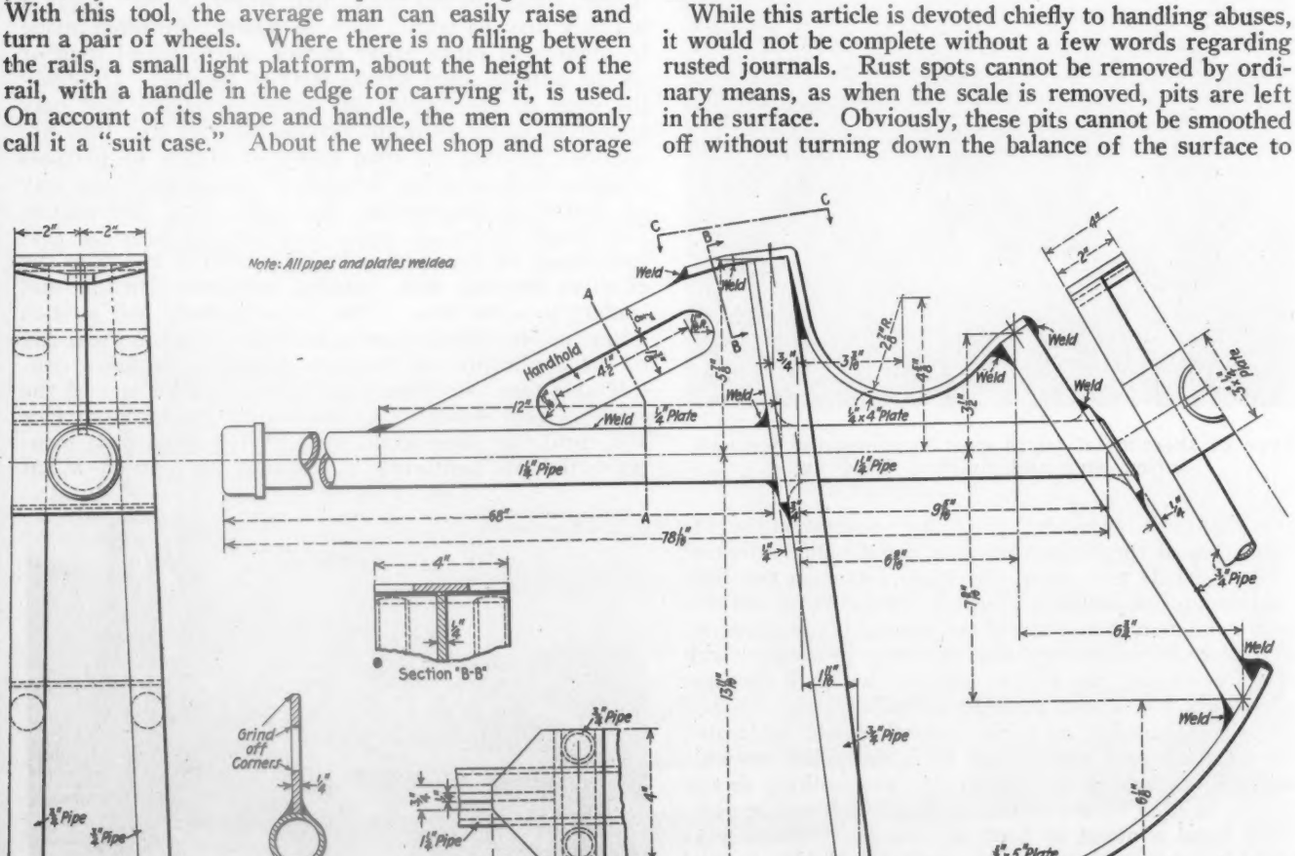
A Convenient Device for Turn-Handling Mounted Wheels

An effective tool for turn-handling mounted wheels, illustrated, is of welded tubular construction with a 5/8-in. by 5-in. rounded steel plate forming the base. With this tool, the average man can easily raise and turn a pair of wheels. Where there is no filling between the rails, a small light platform, about the height of the rail, with a handle in the edge for carrying it, is used. On account of its shape and handle, the men commonly call it a "suit case." About the wheel shop and storage tracks, various devices may be used for turn-handling wheels. Electric and air hoists; a brake cylinder set below the floor at the center of track intersections and equipped with a removable fork; a light, quick operating turntable; a tram-roller arrangement; the collar stick and plate mentioned above; the device illustrated; and others.

In handling wheels, care must be exercised to prevent battering the journals, a common form of this abuse being to permit the flange or rim of one wheel to strike the journal of another. Journals may be battered while handling axles in the wheel shop. The use of chains or other metal slings on journal faces must not be permitted. Shields must be used on journals in the mounting and dismantling press to prevent the wheel bores from marring the smooth surfaces.

Should a journal be nicked or scratched, proper care must be used in correcting the defect. The 10-in. and 12-in. coarse mill files that once constituted a part of the equipment for smoothing a journal must be banned. A 4-in. mill file is about the largest that should be permitted. Great care must be exercised in the use even of this size. The filing action should be confined to the raised area of the nick and the raised ridge of the scratch, and to trimming off any sharp cutting edges that may be present. This file must not be permitted to scratch the polish on the unimpaired surface of the journal. Filing a rough journal is bad practice, as such a journal has an irregular surface, which, combined with the longitudinal movement of the bearing on the journal, effectively prevents the building up of even a moderately good bearing contact. Cut journals should be machine-dressed.

While this article is devoted chiefly to handling abuses, it would not be complete without a few words regarding rusted journals. Rust spots cannot be removed by ordinary means, as when the scale is removed, pits are left in the surface. Obviously, these pits cannot be smoothed off without turning down the balance of the surface to



An effective device of welded tubular construction for turning mounted car wheels

the level of the bottom of the pits. This is resorted to only in extreme cases, as, ordinarily, the rust spots are removed by rubbing down with sandpaper or emery cloth. This is often done in a big-hearted way where only a few spots are being removed, and, as a result, the smooth glaze on the journal is badly scratched by the abrasive used. In the first place, journals should not be permitted to become rusty, but if this does occur, the rust spots should be removed and the sharp edges of the rust pits smoothed without marring or scratching the journal in general. Ordinary rust spots should be removed by using a small piece of sandpaper on the end of the finger and confining the rubbing to the rusted spot.

Protecting Car Journals Against Rusting

The protection of journals on mounted wheels against rusting is quite a problem. A coating of thickened oil is easily applied and easily removed, but it washes off too readily, and it becomes necessary to recoat journals at frequent intervals of time. Paint or a coating containing paint material makes a reasonably effective covering, but it dries so hard and is so difficult to remove that the journal surface is injured in the removal process.

Cheap, heavy greases are fairly effective, but they collect cinders and grit that are likely to cause injury to the journal surface when the grease is removed. Also, heavy rains may wash through them. A number of quite effective greases are not easily washed off by the weather and, yet, may be easily removed, when desired. These, while rather expensive for day-to-day use, are economical for use on journals that are in storage for some time. They also collect cinders and grit.

An effective means for protecting the journals from rust consists of a sleeve made of light material, such as stove-pipe iron, made to slip over the end collar and up over the dust-guard collar. This shield is slipped over the journal after the latter has been given a coat of heavy oil or grease, and it effectively protects the journal from rain, snow, cinders, etc.; eliminates the necessity for frequent greasing; is easily applied and removed; is very cheap; and, with a little care, will withstand years of service. Also, the oil coating on the journal may be easily removed without injury to the polished surface.

Where rip tracks are not platformed between the rails, a cheap and convenient device on which to run out the wheels may be made from the channel backs of two old brake beams, with spacer pipe rods to hold them to track gage. These are notched at the ends that rest on track rails, high enough for the wheel flange to clear the rail. The device is slipped under the wheels after they have been raised and turned quartering. The wheels may then be rolled out with little effort.

Where a standard-gage service track is used, and space between the service track and repair track is not platformed, a portable dummy track, of light construction that may be quickly laid to bridge the gap, will be found a great labor-saver and, incidentally, a journal-abuse preventative. For convenience in storage, these devices should be made to be hooked together by spacer bars so that assembly and dis-assembly may be quickly made.

Where only a moderate number of wheels are handled daily, if track spacing permits, a standard-gage service track for rolling the wheels is about the cheapest mode for transporting them and, if platformed, makes a good roadway for tractors, trucks, etc. Tractors equipped for wheel haulage and handling, as well as for handling other material, make a useful piece of equipment where operating conditions for such a device are favorable, and where there is sufficient work for such a tractor to warrant the investment and operating expense. Narrow-gage service tracks, with platform trucks for hauling wheels and other heavy materials, have long been in use, chiefly where there is insufficient room for a standard-gage installation.

Laying Out Car-Wheel Storage Tracks

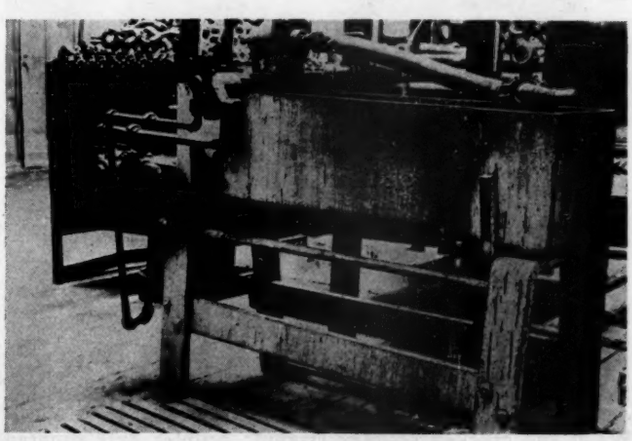
A word about wheel-storage tracks. These should be so laid out as to permit a complete segregation of different classes of wheels as to journal sizes, new or second hand, etc., so that no unnecessary handling may be involved. To insure continuous rotation of wheel stock, the storage tracks should, if possible, be so laid out that wheels are rolled in on one end of these tracks and taken out from the other. Where this cannot be done, other measures must be taken to insure rotation of wheel stock.

Ordinarily, double tracking of wheel-storage tracks is best. Where mixed-wheel sizes and journal lengths are stored on the same pair of tracks, the spacing of the tracks must be such that the wheel on one track will clear the end of the journal of the wheel on the mate track. Where the storage track is for wheels of the same size and the same journal length, the best double-track layout is to have the adjacent rails so laid that the wheels will just clear each other. In that way, considerable space is saved. Another desirable arrangement that will pay well where wheels are handled by any of the ordinary methods is to have the two tracks converge at their outlet to the cross track or platform, and thus avoid the duplication of handling devices.

Final Test for Air-Brake And Signal Hose

BEFORE air-brake or signal hose are shipped from the air-brake room and placed in stock for service they should be given a careful test to determine whether or not the clamps are sufficiently tight to prevent the nipples or clutches from blowing out or to assure that the rubber tubing is not defective. The test-rack shown in the illustration is used by an eastern railroad and each hose that is mounted is carefully tested before it leaves the hose shop.

A metal trough, mounted as shown, is filled about half full of water. The hose is pushed over an expander nipple on the nipple end and a dummy clutch is attached to the clutch end. An eight-inch brake cylinder, attached on the left side of the trough lowers the hose into the water. Then about 70-lb. air pressure is turned into the



A testing rack that eliminates leaky hose

hose and a careful inspection made by the operator to determine if any leak exists.

No matter how carefully the mounting of air or signal hose is done there is a possibility of defective materials or workmanship existing. This test will eliminate hose being placed in service that will cause excessive brake-pipe or signal-line leakage or hose blowing off the connections under high air pressure in freight- or passenger-train service.

Reclaiming Couplers And Follower Blocks

THE Illinois Central has recently perfected and installed at a number of shop points a method of reclaiming cracked and worn couplers and Farlow follower blocks which adds greatly to the service life of these parts, with only a small expenditure for the reclamation operations.

In the case of couplers with cracked heads for example, the heads are closed in by a heavy hammer or pneumatic press until they take the A.R.A. gage, the cracks then being V'ed out with the cutting torch and welded, using a special steel rod and the oxy-acetylene welding torch.

Worm coupler butts are rebuilt to the standard length by the following method: The end of the coupler butt is first squared using a special fixture on a draw-cut shaper which takes a cut to remove ⅜ in. or ½ in. of metal depending upon the thickness of plate required to bring the coupler butt back to the standard length. This plate, provided with a hole in the center to accommodate the horn of the follower block, is electric welded in place. An average of .7 lb. of welding material per coupler is used. The production with one operator is about five coupler butts an hour.

The follower blocks are machined on a boring mill in three minutes, floor to floor, enough material being removed to make a square bearing for a ⅜-in. steel plate, bronze welded in place. The plates used are 40 to 50 point carbon steel of not less than 250 Brinell hardness. They are provided with a hole to accommodate the horn of the follower block. About ⅝ to ¾ lb. of bronze is used per block with an average output of four blocks an hour. One of the illustrations shows the operation of welding a plate on a follower block, and another shows a block and a wear plate before and after welding. The third illustration shows at the right a coupler before reclaiming, a coupler after machining is shown in the center, and a reclaimed coupler is at the left.

Worn and cracked coupler (right); coupler butt squared (center); carbon steel wear plate applied by electric welding (left)

Worn follower block before and after reclamation by bronze welding—Carbon steel wear plate shown at the left

The holding fixture used in machining the coupler butt is of special interest because of its simplicity and effectiveness. It consists of a forged horn securely bolted to the table of the draw-cut shaper and arranged to pass into the eye of the coupler, held in a vertical position. A back-stop and quick-holding nut and split washer complete the fixture. Coupler-butt ends can be machined and squared almost as fast as they can be slipped on and off the holding fixture. To facilitate handling, the couplers are taken to the shaper on skids, loaded in a vertical position and requiring only a short lift to the holding fixture. The machining time "skid to skid" is less than 3 min. per coupler.

Welder applying 40-point carbon steel wear plate to worn block by the bronze-welding method

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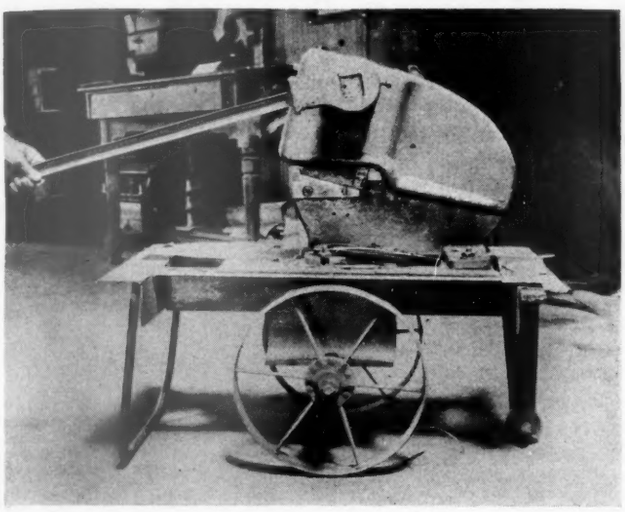
A 1,000,000-MILE SAFETY RECORD.—Here is a real safety record. Locomotive Engineer Ben Smith of the Louisville & Nashville went to work on the throttle side of an engine cab in July, 1902. Since that time, he has accumulated a total of well over 1,000,000 miles, and not once has he himself suffered the slightest injury or caused injury to anyone else. Any locomotive engineer who can successfully dodge automobiles at grade crossings for more than 30 years deserves a lot of credit.

A Portable Hand Shear

A small hand shear is more convenient if it can be moved to the work instead of bringing the work to the shear. The shear arrangement shown in the illustration was made by welding sections of 4-in. by 4-in. angles into a rectangular frame. The top is of ¼-in. plate and welded to the frame. The small shear is bolted near



Hand shear mounted on a two-wheel truck for easy transportation around the car-repair yard or shop

one end of the frame as shown. The shear and frame are transported on two wheels of ample construction. The front end is supported on a roller which is secured to the frame by two angles of small section which are welded to the front frame angle. The front end rests on a loop of 1-in. rod, the ends of which are held in two short sections of pipe welded to the end angle. This loop can be pulled up and used as a handle when moving the shear from place to place.

Decisions of Arbitration Cases

(The Arbitration Committee of the A.R.A., Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Charge for Re-stenciling Not Permitted

The Chicago Great Western included a charge of 80 cents for changing the stenciled light weight and load limit on Chicago, Milwaukee, St. Paul & Pacific car No. 92090, in its car-repair bill against the St. Paul for July, 1931. This stenciling was done because the actual light weight varied 500 lb. from the stenciled light weight, the old date of the previous light weight being April, 1930. Inasmuch as the objections to this monthly bill did not exceed 10 per cent of the total, the bill was passed for payment by the C. M. St. P. & P., but a request was made for counterbilling authority which included 80 cents to offset the stenciling charge. The owners felt that this charge was not authorized under Rule 31 because the stenciling was on account of re-weighing and not because the old marks were indistinct, the car owners contended that according to Rule 30, Section (c), this car was not due for periodic re-weighing and re-stenciling on July 21, 1931. No repairs or alterations, it contended, has been made to the car by the Chicago Great Western and, therefore, the intermediate re-weighing or re-stenciling was not chargeable to the car owner, inasmuch as the actual weight did not vary 1,000 lb. or more from the stenciled weight. The Chicago Great Western in its statement contended that the conditions surrounding the weighing of the car were such as to conform with the requirements of Section (f), Rule 30, it agreed that the car could not be considered as being re-light-weighed under the provisions of Rules 30 or 31 and for that reason did not attempt to charge for re-light-weighing the car. The charge of 80 cents for re-stenciling was made against the car owner in accordance with Item 419-B, Rule 107. The handling line contended that inasmuch as it is a requirement of Rule 30 that a box car with a variation of 300 lb. or more must be restenciled, it is also the purpose of these rules to reimburse the road for its work in performing this service.

The following decision was rendered April 7, 1932: "Bill for stenciling the car is not permissible inasmuch as no charge can be made for re-light-weighing under the provisions of Rule 31. The contention of the Chicago, Milwaukee, St. Paul & Pacific is sustained."—*Case No. 1700, Chicago, Milwaukee, St. Paul & Pacific vs. Chicago Great Western.*

Unnecessary to Renew Letters When Re-stenciling for New Weight

The Chicago, Rock Island & Pacific rendered a charge for re-weighing and re-stenciling New York, New Haven & Hartford car No. 161124 at Ottawa, Ill., January 2, 1930. The car owners issued a joint-evidence statement at New Britain, Conn., July 30, 1930, which indicated that the car was re-stenciled on the same date due to "old light-weight markings not entirely painted out per Rule 30, Section 6; figures only in load limit, light weight, station symbol and date, painted out." They wrote the Rock Island August 8, 1930, and attached the joint evidence requesting a counterbilling authority to cover the cost of re-stenciling the car. The Rock Island replied August 19 claiming that it was its understanding of Rule 30 that it was not necessary to paint out and re-stencil the lettering for the words or abbreviations, "Capacity," "Light Weight" and "Load Limit," unless they were illegible. It refused the request of the New Haven for counterbilling authority to cover the cost of re-stenciling the car as the joint evidence card failed to show that it had permitted any indistinct or illegible stenciling to remain without renewal or that it had failed to re-weigh the car properly. The New Haven contended that paragraph (f), Section 6, of Rule 30, also Arbitration Case No. 1621 and A.R.A. Circular 568, made it mandatory for the company which does the re-weighing to paint out all the old stencil marks with quick-drying paint. The owners claimed that the charge of $4.35 in Item 419-A, Rule 107, covered the painting out of the words "Capacity," "Load Limit" and "Light Weight" and all numerals and re-stenciling.

The Arbitration Committee rendered the following decision November 4, 1932: "It is the intent that the date, station symbol, light weight and load-limit numerals (where the latter is not preceded by star symbol) must be entirely painted out and renewed when the car is re-weighed. If the letters "CAPY," "LD LMT" and "LT WT" and capacity and star symbol load-limit numerals

are distinct, it is unnecessary to paint out and renew them, but in any case where such markings are indistinct, same should also be re-stenciled. As joint evidence failed to show that such markings were indistinct or illegible, the contention of the New York, New Haven & Hartford is not sustained. (Note: This decision has been concurred in by the Committee on Car Service of the Transportation Division, American Railway Association.)"—*Case No. 1702, Chicago, Rock Island & Pacific vs. New York, New Haven & Hartford.*

Bearings Applied to Cut Journals For Short Haul

On August 15, 1931, the Akron, Canton & Youngstown delivered its car No. 1063 to the New York, Chicago & St. Louis under load at Bluffton, Ohio, bearing A. C. & Y. defect card dated August 15, 1931, for "two pairs of cast iron wheels with cut journals, L1 and L3." The N. Y. C. & St. L. bill No. 8472 for August, 1931, amount $92.84, included charges for two new solid journal bearings, L1 and L3, applied at Bluffton on August 15, to enable the car to be moved to Lima, Ohio, for repairs, and for two pairs of wheels renewed, L1 and L3; four new journal brasses, R and L and three dust guards; journal-box bolts, etc., which were applied at Lima, on August 16, 1931. The car owners claimed that as the car was protected by a defect card the charges should be confined to two pairs of wheels renewed; four new journal brasses, R and L, and three dust guards; journal-box bolts, etc. The handling line claimed that, in accordance with Interpretation 1, Rule 99, it was justified in billing the car owner for the first application of journal bearings at Bluffton, where it had no facilities for changing wheels, regardless of the fact that the journals were cut and covered by a defect card for the work done as previously described. The A. C. & Y. did not believe it to be the intent of the rules to penalize the car owner or the delivery company for an application of journal bearings to enable the receiving line to move the car to a repair track for the application of wheels, especially when the journals were cut when the car was offered and accepted in interchange. It was its opinion that such repairs should be classified as temporary, or no repairs.

The Arbitration Committee rendered the following decision: "The defect card attached to the car was an acknowledgment that the journals were cut. The application of bearings to the cut journals constitutes repairs for which a charge is not permissible. The contention of the Akron, Canton & Youngstown is sustained."—*Case No. 1701, Akron, Canton & Youngstown vs. New York, Chicago & St. Louis.*

A Protective Coating for Workmen

THE DeVilbiss Company, Toledo, Ohio, has recently placed on the market a new product known as Pro-Tek, which has been developed especially for workmen who work with materials such as lacquer, paint, varnish, grease and oil. Pro-Tek is a white cream which, when rubbed into the skin before working, forms a protective film against such materials as lacquer, and which is soluble only in water. It is said that Pro-Tek prevents dirt and liquid from entering the pores of the skin and serves as an "invisible glove."

When using this protective coating, lacquer, paint, grease, metallic dusts and similar materials can be quickly and completely removed by washing under running water. It is claimed that many industrial skin diseases can be prevented by the use of Pro-Tek and that its use should appeal to painters, industrial finishers, mechanics, battery men, pipe fitters, electricians and platers.

Safety Tool for Hopper-Car Doors

A TOOL, known as the Prescott safety tool, designed to eliminate many of the serious accidents that have occurred in closing the doors of hopper bottom cars has recently been placed on the market by the Trumbull Manufacturing Company, Warren, Ohio. The Prescott safety tool is adapted for use on any car equipped with the Wine or similar type door latch.

Prescott safety tool being used to close hopper doors

Advantages claimed for this tool are the ease with which it is possible for an operator to close the door and the speed with which it may be done.

The forged parts of the Prescott tool are constructed of high carbon-steel forgings and the castings are of malleable iron. The illustration shows the manner in which this tool is used to close hopper doors. The chain on the tool is adjusted through the clamp to the proper length so when the hook is attached to the open door the fulcrum portion of the bar reaches the upper face of the angle extending across the hopper incline sheet, running parallel to the door. The handle extends at almost right angles to the side of the car. When this has been done, the handle is pulled in an almost horizontal direction toward the car until the door locks.

NEW EQUIPMENT INSTALLED.—Class I railroads in the first eleven months of 1932 placed in service 2,951 new freight cars, the Car Service Division of the American Railway Association has announced. In the same period last year, 12,328 new freight cars were placed in service. The railroads on December 1 this year had 2,398 new freight cars on order compared with 4,252 on the same day last year.

In the Back Shop and Enginehouse

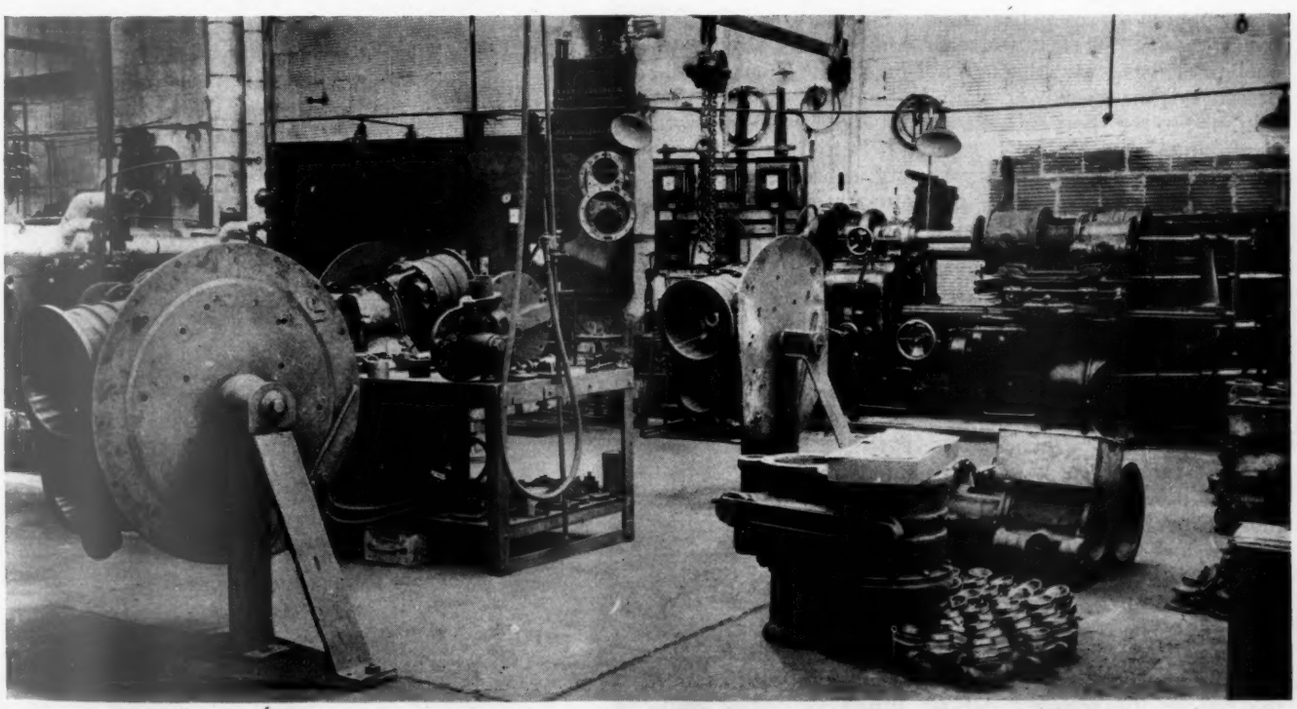
Air-Compressor Repairs On the Burlington

AIR-compressor repairs for the entire Chicago, Burlington & Quincy system are made at the Aurora (Ill.) shops, with the exception that on locomotives sent to the West Burlington (Iowa) shops or the Denver (Colo.) shops for general repairs have their compressors overhauled locally. Air compressors are given general repairs on the basis of from 70,000 to 100,000 miles per shopping, depending on the class of service. Each compressor carries a date plate applied to the jacket with rivets and indicating the compressor serial number, date of application, date of last overhauling and actual cylinder sizes. Compressors removed from locomotives at outlying terminals are bolted to lift-truck skids and turned in to the local storekeeper in exchange for overhauled compressors, which can be applied without loss of time. The worn compressors are handled by the stores department to Aurora shops, and after being repaired are shipped back in regular store-house line cars which deliver them and other material regularly once or twice a week in accordance with the needs. Compressors remain on the skids throughout the entire movement and the steam-cylinder jackets are protected against dents or accidental marring by means of extra-heavy protection jackets applied temporarily outside of the regular steam-cylinder jackets. To meet the present needs of the Burlington, approximately three new or thoroughly overhauled 8½-in. cross-compound compressors are required daily; also one 9½-in. and two 11-in. compressors. The Burlington is gradually standardizing on the use of the 8½-in. cross-compound compressor, in view of its larger capacity and greater efficiency than the other two types.

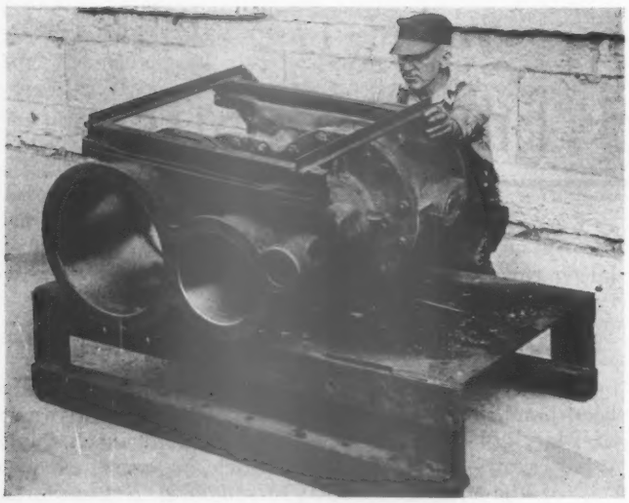
Aurora Air-Compressor Repair Operations

Air-compressor repairs for the Burlington system have been handled at Aurora shops only since the early part of March, 1932. As in the case of centralized triple-valve repairs, described in an article beginning on page 335 of the August *Railway Mechanical Engineer*, the repair work on air compressors is featured by its thoroughness and accuracy, the use of gags to secure interchangeability and micrometer measurements in determining wear and clearance limits. These wear limits and tolerances conform in general to standard practices on other roads, being described in detail in a compact and convenient booklet entitled "Burlington Lines' Air-Brake Standard Practices for Maintenance and Tests." The most important way in which the Burlington air-compressor repairs depart from ordinary practice is in the progress testing of each unit of the compressor as it is assembled, in order to permit the early correction of defects which, if undetected before the final test, might necessitate the more or less complete dismantling of compressors with attendant delay and expense. The details of this method of progressive assembly and test will be given subsequently in this article.

Before undertaking to repair compressors on a production basis at Aurora shops, the complete layout of the shop and its facilities was studied with a view to eliminating lost motion and arranging the repair and testing equipment for most convenient operation. The space



Aurora air-compressor repair department—Micro grinder in background



Use of rectangular, welded T-iron gage for checking lug alinement

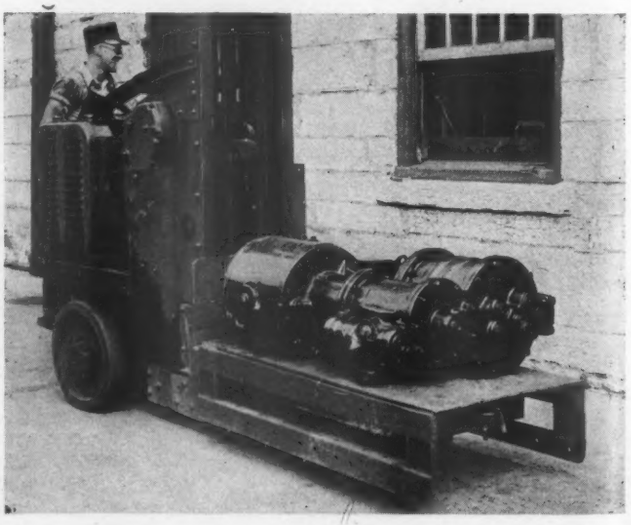
in the air-brake shop devoted to compressor repairs is served by a light, hand-operated overhead crane of sufficient capacity to handle the heaviest compressor, namely, the 8½-in. cross-compound compressor which weighs approximately 1,400 lb. A work bench with vise equipment and tool drawers is provided; and there are four air-compressor stands with vertically-rotating tables held in any desired position with respect to the fixed pedestals by means of a hook and split-key locking device. Holes, properly spaced, in the revolving plate permit holding the compressor, as illustrated in any position for most convenient handling of the work. A Micro Model-FG internal grinder is used for truing worn cylinders and a Heald No. 55 internal grinder for truing worn main and reverse-valve bushings. The Micro grinder is served, as shown in one of the illustrations by a jib crane and a one-ton chain hoist. In the background of the same illustration is shown a conveniently-located material table and rack. A steam-test rack is provided for the thorough testing of air compressors before delivery to the stores department. This test rack, which has a capacity to test four air compressors simultaneously, receives steam through a 4-in. line at about 150-lb. pressure from the power plant and exhausts through an 8-in. line to the shop exhaust-steam heating system. Both steam lines are carefully lagged to avoid unnecessary heat-radiation losses. Every facility is provided for the easy bolting of compressors to the test rack and the convenient attachment of steam and air connections; also all test gages and appliances.

Compressors Stripped Near Lye Vat

Owing to the location of the lye vats at some distance from the air-compressor repair department, arrangements have been made for the complete stripping and dismantling of all air compressors at Aurora shops in another part of the plant adjacent to the lye vat. Two elevated rails are provided at a sufficient height so that the compressors, when mounted on skids, are at the most convenient height for working. One machinist helper does all of the stripping, being equipped with necessary tools, special wrenches, etc., required for dismantling compressor parts without damaging them. For example, a heavy steel dolly bar, drilled and threaded at one end is screwed on the threaded end of the piston rod and protects this thread when breaking the fit of the rod in the piston. All air compressors are completely dismantled, with the exception that the joints between the cylinders and the center casting are not broken unless there is evidence of a blow due to a defective gasket, or one of the castings is cracked.

A strong solution of lye or caustic soda is used in the lye vat, being kept as nearly as possible at the boiling point. After being cleaned, all air-compressor parts are washed off with hot water and steam and then replaced on skids or in metal boxes for handling by a lift truck to the air-compressor repair room. Here they are critically inspected and gaged for wear. Every compressor is checked with a special rectangular welded T-iron gage to make sure that all four lugs are in the same plane. Otherwise, when drawn tightly to the holding bracket on the locomotive and subjected to shocks and jars in service, a broken lug is almost sure to result. The use of this gage is clearly shown in one of the illustrations. Cracked or defective lugs of any kind are repaired at Aurora shop by oxyacetylene welding, using a manganese bronze metal and subsequently planing down the lugs, if necessary, to assure a uniform bearing on the holding bracket. Hole locations are checked and the holes plugged and redrilled, if necessary. Stuffing boxes in the center casting are examined for loose or stripped threads, and these conditions, if found, are corrected by the removal and repair of the boxes, including the proper tightening of the boxes and reapplication of dowel pins at new locations.

Steam and air cylinders are carefully checked and, if out of round, scored or tapered, are thoroughly reconditioned on the Micro grinder, being subsequently checked for accuracy with a micrometer dial indicator. Particular attention is paid to the alinement of cylinders, which are checked carefully with proof grooves machined on each end. The use of these proof grooves, in conjunction with the indexing feature on the Micro grinder, assures accurate alinement of cylinder centers. If the cylinders are more than 1/32 in. out of round on the diameter, a rough boring cut is taken preliminary to grinding, in order to avoid the removal of so much material by the grinding wheel and to save time. All cylinders over 1/64 in. out of round are ground. When completed, a tolerance of .003 in. out of round or tapered is the maximum allowance. Cylinders are rebored or ground in steps of 1/16 in. above standard. They are counterbored ½ in. deep and provided with by-pass grooves 2 in. long, ⅝ in. wide and 3/16 in. deep. Oversize pistons are carried in stock so that it is only necessary to turn down the outside diameter to suit the cylinder sizes. A clearance of 1/64 in. in the cylinder is



Lift truck and skid handling overhauled compressors

the maximum permissible. The packing-ring grooves are sufficiently deep so that standard diameter rings, properly fitted, can be used.

Pistons are not continued in service when more than 1/16 in. smaller than the bore of the cylinders. Piston rods are renewed when the diameter has been reduced to 1/16 in. smaller than the standard size. Piston packing rings for steam cylinders are condemned when the ends are 3/64 in. apart when placed in the smallest part of the cylinder. For the air cylinders, the rings are condemned if the ring ends will not come together when placed in the smallest part of the cylinder. New rings are fitted so that they will develop a slight amount of friction in the ring groove when passing the smallest cylinder diameter.

New stuffing boxes are bored 1/32 in. larger than the rod and condemned when 3/64 in. larger than the rod. The cylinder of the main-valve bushing and the left main-valve head are renewed if worn 1/32 in. or more, great care being exercised to assure proper alinement of these two parts. Reversing valves are scraped when the distance between the reversing-rod groove and the valve seat is ⅛ in. less than standard, or when the valves are 1/32 in. loose between the two rod shoulders. The combined wear of the reversing-valve face and bushing seat is not permitted to exceed ⅛ in.

In accordance with usual practice, the standard lift of all air valves is made 3/32 in. and not allowed to exceed ⅛ in. All valve stops are trued, when required, and valves ground in, first making sure that the wing-guide play in the cases does not exceed 1/32 in. Seats and cases are renewed when the base forming the guide for the valve wings is worn 1/32 in. larger than standard. Copper gaskets are cleaned, annealed, rebeaded and reapplied, with the exception of a certain amount of new gaskets necessary for replacement.

Compressor Tests During Process of Assembly

With the high-pressure steam and low-pressure air piston and rod (pistons containing fitted rings), stuffing boxes and rod packing, and all air valves assembled, both top intermediate air valves are bolted down. The top of the steam channels between the steam cylinders is plugged with a blind gasket, and, without either the top steam head or the bottom air head applied, shop air pressure is connected to the drain hole on the bottom of the high-pressure steam cylinder. This will test the centerpiece gasket, the high-pressure steam cylinder packing rings, the stuffing box and the rod packing for leakage. Any leakage can be readily determined by swabbing the parts with thin oil. Any defective condition is noted and corrected.

The next test is made by removing the shop air line from the steam cylinder and applying it to the low-pressure air-cylinder oil-plug hole, noting that no leakage exists backward through the inlet air valves or by the valves or seats to the high-pressure air cylinder. It is also important to note that leakage is not excessive by the air piston rings, and that no leakage exists by the stuffing box or rod packing, or the centerpiece gasket. Shop air pressure is then applied to the final discharge tapped opening to test for any leakage that may exist by the final discharge valves or seats.

The third test is made by installing the low-pressure steam and high-pressure air piston assembly and applying shop pressure to the high-pressure air cylinder, making the connection at the oil-plug hole, bolting down the top final discharge valve, and testing for leakage by the packing rings, also noting any other defective conditions which are corrected as found.

In the fourth test, the procedure is to plug all drainage and oil holes, remove the blind gasket from the steam channels, remove the bolted air-valve caps, and apply the steam head, leaving the air head off. The compressor is operated with the shop-line air pressure, connecting the discharge opening of the air cylinder to a reservoir, approximately 14 in. by 33 in., and examining both air pistons for blow, also the steam head for blows or defects. If the air pistons blow excessively, the air in the pressure reservoir will not pump up to equal the shop pressure which it should do within a few pounds if the compressor is efficient.

The fifth test consists of three parts as follows: *A*—Apply the bottom air-cylinder head with all air valves assembled. Attach the shop air line to the plug in the low-pressure bottom air head, plugging the final discharge pipe opening. Admit full shop pressure and note any leakage to the atmosphere by the bottom intake valve, using the soap-bubble test. Any leakage found must be corrected before proceeding further. *B*—Apply shop air to the plug hole in the bottom of the high-pressure air-cylinder head. Admit full shop air pressure and note any leakage at the plug hole in the bottom low-pressure air-cylinder head, using the soap-bubble test which will indicate leakage by the lower intermediate valves. Any leakage found must be corrected. *C*—Remove the plug from the final discharge opening and apply shop air at this point. Note any leakage at the plug opening in the bottom high-pressure air head, using the soap-bubble test which will indicate leakage by the lower final discharge valve. Correct any leakage found.

In the sixth test, plugs are replaced in the bottom air head. The discharge opening is connected to the test reservoir and shop air is piped to the steam inlet to operate the compressor. If the steam and air ends are efficient, the pressure will rise 15 to 20 lb. higher than the shop pressure. The test reservoir is equipped with a safety valve set at 20 lb. higher than the standard shop pressure.

Following the progressive testing and assembly of the air compressors, they are given the standard orifice and steam-end speed tests, lubricators applied, the compressors mounted on skids and delivered by lift truck to the stores department for shipment to outlying terminals, as required.

Reversing Valve-Bushing Press

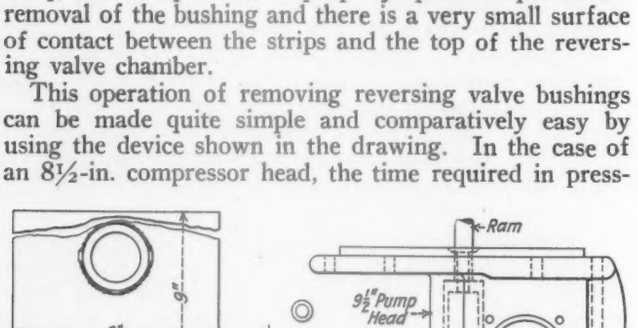
THERE are many methods of pressing out worn reversing-valve bushings from air-compressor heads. Each shop has its own method and the most common of these involves the use of parallel strips, such as two old driving-box shoes. These are placed on the hydraulic-press table and the compressor head is placed on these strips in an inverted position. In the case of a 9½-in. pump head, the head must then be levelled by placing shims under the edges of the head, due to the irregular contour of the surface of the head. The bushing is then pressed out by the effort of the hydraulic ram acting on a small steel ram which is placed on the bushing.

This method has many disadvantages. It requires much time in properly alining the head and even then many head castings are broken. If the head is not perfectly alined and an attempt is made to press out the bushing, undue stresses are set up in the casting and the result will be, in many cases, a broken casting.

In the case of an 8½-in. compressor head, the method used is practically the same as in the 9½-in. head except

that there is no irregular surface to shim and square but the parallel strips must be properly spaced to permit the removal of the bushing and there is a very small surface of contact between the strips and the top of the reversing valve chamber.

This operation of removing reversing valve bushings can be made quite simple and comparatively easy by using the device shown in the drawing. In the case of an 8½-in. compressor head, the time required in pressing out reversing-valve bushings has been reduced to one-fourth the time required by using parallel strips. In pressing out 9½-in. air-compressor reversing-valve bushings, the time has been reduced to one-sixth the time required by using parallel strips. In the case of the latter, there are no more broken castings during this operation.



General designs and dimensions of a convenient device for removing reversing valve bushings

This device is easily made and is cheap in construction. The base is made of ½-in. boiler plate and is 8 in. square. The receiving tube is made of 2⅛-in. by 3⅛-in. steel tubing and is 6¼ in. in length. This tube is spot-welded to the base. There are three guides, spot-welded to the top of the tube. They are made of ¼-in. by ¾-in. by 1½-in. flat iron and project ¾ in. above the top of the tube. The steel ram is made of mild steel and is machined as shown in the drawing.

The operation of this device is simple. The pump head is inverted and is placed on the device stand as shown in the drawing. The head is brought in contact with the three guides and they properly aline the head to the correct position with respect to the stand. The steel ram is then placed on the reversing valve, as shown, and the bushing is then removed from the compressor head by the effort of the hydraulic ram on the small ram.

The dimensions given in the drawing are for the device used in connection with 9½-in. compressor heads. The device used for 8½-in. compressor heads is of the same design, only the dimensions vary.

Due to the simplicity in design, the cheapness in construction and the time saved by this device, to say nothing of the castings saved which were formerly broken by using other methods, it is valuable device to have in each shop where air compressors are reclaimed.

A Revenue-Producing Dining Car.—The Norfolk & Western recently operated a diner in one of its fast freight trains, and made money out of it. It was a lunchroom built to resemble a dining car, and it made a trip over the railway as a freight shipment, mounted on a flat car. These "diners" are large enough to accommodate 20 people at a time and are completely equipped with stoves, lunch counters, seats, show cases, dishes, cupboards, etc. Of solid steel construction, the "diner" is 40 ft. long, about 8 ft. in height and weighs 40,000 lb.

Spot Welding The Stainless Steels

*By V. W. Whitmer**

STAINLESS steels are particularly well adapted to spot welding due to their clean surface, freedom from any oxide or scale and because of the absence of any coating such as zinc or lead, as on galvanized or Terne Plate stock.

Spot welding, in principle, is nothing more than holding two sheets in close contact between two copper electrodes about an inch or so in diameter with the contact ends tapered to about ⅛ in. in diameter, and passing a current low in voltage but high in amperage through the circuit for a short period. Fusion immediately takes place between the two sheets, while the excess heat is rapidly carried away from the outside surfaces by the water-cooled electrodes. The low voltage, about 2 to 4 volts, is obtained from a step-down transformer wound in sections, each being connected with a stop on a rotary control switch by which the current or heat can be increased or decreased by turning up or down respectively.

While the total heat applied will be determined by the rotary adjustment, the area of the electrode points should be maintained as near constant as possible. Any increase in area will tend to reduce the heat per unit area, resulting in an improperly or poorly fused joint. A decrease in area will increase the unit heat and will usually burn a hole entirely or partly through the sheet to be welded, other factors remaining constant.

The pressure exerted by the electrodes is generally produced by the compression of helical springs and can be adjusted by a lock nut on a shaft through the center of the spring. Variable pressures will also affect the quality of the weld. Too much pressure will reduce the resistance of the joint and hence tend to decrease the heat generated. The pressure generally determines the amount of up-set displacement directly following the fusing period, producing an indentation on each side of the sheets welded.

In addition to these variables, the time of current flow is of great importance. Too long a period gives the same result as too much heat. Too short a contact will produce no weld.

It is evident, therefore, that spot welding depends on the following four variables: Current (controlled by rotary switch), diameter of electrode contact points, pressure (controlled by spring or pneumatic pressure), and length of time the current is allowed to flow.

While it would not be impossible to determine an adjustment of each of these with respect to the other for each gauge to be welded, as in the case of automatic machines where time and pressure are accurately controlled by motor-driven cams and the current set by hand, it would be next to impossible to determine same for manual operation, due to the personal element. Furthermore, such adjustment would be necessary for each individual machine. This makes it impossible to set up any specific procedure to follow for this class of work. However, stainless steel, such as Enduro, in general will require less heat than the same gauge in common steel, due to its lower heat conductivity (tending to concentrate it in one spot), its lower melting point and better contact due to a scale-free surface. Consequently, if an operator is producing good work on say 20-gage black steel, he could, in general, change to the same gauge stainless by either dropping the switch one point or reducing the time slightly, or both. More definite

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* Metallurgist, Republic Steel Corp.

instructions cannot be given but the exact procedure must be worked out individually, balancing one variable against the other until the desired result is obtained.

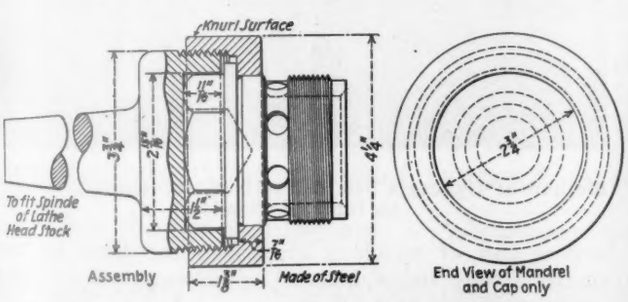
If both electrodes are of the same diameter, a depression will occur on both sides which, while not serious on the pickle finishes, may be objectionable on the polished surfaces. This can be reduced by using a copper block about ½ in. thick and 2 in. square between the electrode and polished side, thus putting the major depression on the lower side. An aluminum block ⅛ in. to ¼ in. works even better but due to its lower melting point, will tend to pit if a slight arc is drawn. This procedure will reduce the depression but will not eliminate it entirely, as it is due to shrinkage of the molten metal in the center and, hence, pulls from both surfaces. The indentation remaining, if the work is to be polished, will have to be ground out with a cotton wheel set up with glue and abrasive. (Use about 80 grit or finer.)

When welding polished stainless steel, it is advisable to place the welds at the least conspicuous positions, as often it is difficult to refinish the welds and have the same color if the whole piece is not refinished. This depends, however, to a great extent, upon the finish of the sheets.

Spot welding, like any other type of welding requiring high temperature, will form an oxide on the surface which will be blue in color. If this is exposed to the weather or moist conditions, it will slowly change to a brown color resembling rust. This, however, is only a surface condition, affecting the original oxide only. If such welds are to be exposed to the atmosphere, they should be cleaned either with acid as in pickling in the case of No. 1 finish sheet, or ground and polished if No. 4 or higher finishes are employed. In the ground and polished state, spot welds are just as resistant to the salt spray as the original metal.

Mandrel for Air-Pump Valve Cages

AIR-pump valve cages are reclaimed many times before they become unfit for service by merely grinding in a valve to a seat. These cages, which are in constant use on pumps, finally become worn at the seat. The constant hammering of the valve upon the seat of the cage causes the seat or bevel edge to become wide and finally a valve will become "buried" in the cage.



Mandrel for use in reclaiming air-pump valve cages

That is, the outer edges of the valve will sink below the top edges of the cage and the valve is more likely to stick and cause trouble.

These cages may be reclaimed at small cost. The usual method is to "chuck up" the cage in a lathe and cut away the top edges of the seat until the desired result is obtained. This method requires quite a few minutes in chucking and, even then, there is a possibility of an error.

The drawing shows a mandrel which is designed for the large cages of an 8½-in. air-compressor. However, the same design may be used for the small or intermediate valve cages by changing the dimensions.

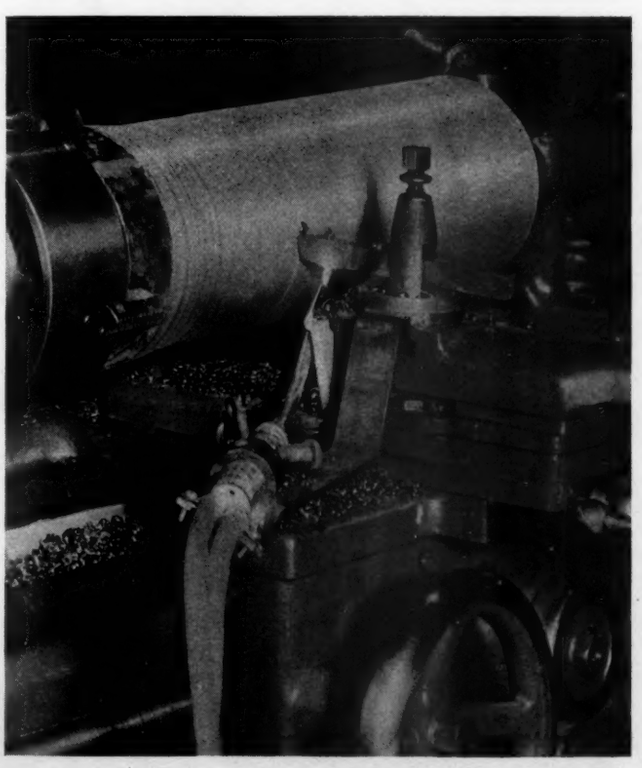
The mandrel shown is made of soft steel and the shank of the body is made to fit the taper and size of the lathe-head stock spindle. The mandrel cap is also made of steel and the outer surface is knurled so as to produce a firm hand grip for operating purposes. By placing the valve cage in the mandrel and clamping, by means of the cap as shown, the cage is held rigid and true for reclaiming. If the cage has a tendency to revolve in the mandrel and cannot be stopped by clamping, a steel pin may be inserted in the mandrel body near the recessed edge, which will act as a "dog" and prevent turning.

In many instances, valve cages will come in the shop with the tops damaged by chisel and hammer marks. These battered places will necessitate filing so as to produce a square surface when it butts against the mandrel.

This mandrel is easily made and cheap in construction. The time saved by this device will in a short time pay for its construction after being put into service and it will produce accurate work.

Demonstration of Stellite Cutting Tools

AT a recent National Metals Exposition at Buffalo, N. Y., demonstration was given of a red-hot cutting tool in actual operation. The demonstration was not given as a life test of the tool but rather to demonstrate the property of red hardness of Haynes Stellite J-metal, a non-ferrous alloy of cobalt, chromium and



Haynes stellite cutting tool heated by oxy-acetylene flame used in a 16-hr. cutting test

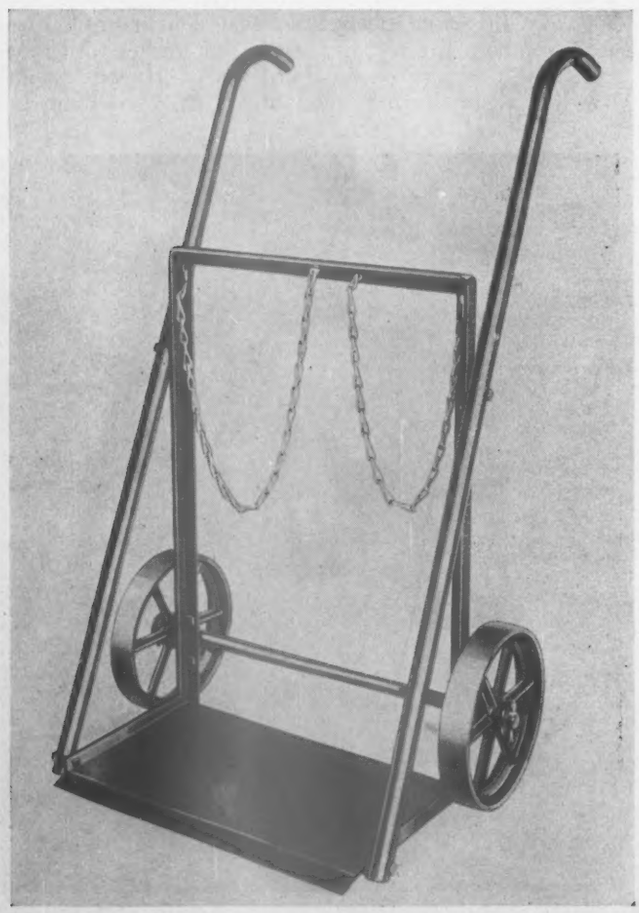
tungsten. The accompanying illustration shows the set-up. The material machined was a hot-rolled steel billet, 5 in. in diameter and 16 in. long with 0.15 to 0.20 per cent carbon and 0.30 to 0.60 per cent manganese. The depth of cut was 0.025 in., the feed 0.004 in. and the speed 130 surface feet per minute.

An 0.4 by 0.5 in. solid Haynes Stellite J-metal tool was mounted with approximately a two-inch overhang. An oxy-acetylene welding blowpipe was adjusted so as to direct a flame on the bottom edge of the tool one inch from the end. In this manner, about 1½ in. of the cutting end of the tool was kept constantly at a red heat, or approximately 750 to 800 deg. C. (1380 to 1475 deg. F.) A small portion of the alloy near the hottest zone of the flame was actually melted.

After 16 hours of continuous cutting, the tool was removed, cleaned up with a stone, and put into service again. The cutting edge of the tool was in good condition and could have cut longer without attention.

Truck for Welding Equipment

THE Linde Air Products Company, 30 East Forty-Second street, New York, has introduced a new cylinder truck which increases the ease and convenience of moving the welding or cutting outfit from place to place in the shop or yard and of transporting the outfit to outside jobs. It insures a firm support for the oxygen and acetylene cylinders, eliminating the possibility of overturning them and breaking the regulators or gages.



No. 5 cylinder truck

The frame of the No. 5 cylinder truck is made of 1¼-in. angle iron welded into a permanently rigid unit. A beveled steel plate welded to the frame forms the cylinder platform. The handles are made of 1¼-in. pipe curved to provide a firm, easy grip. The handles are firmly bolted to the cylinder platform and to the upper part of the frame. Being bolted, they may be easily removed, which permits the truck to be partly dismantled for shipping or storing in a small space.

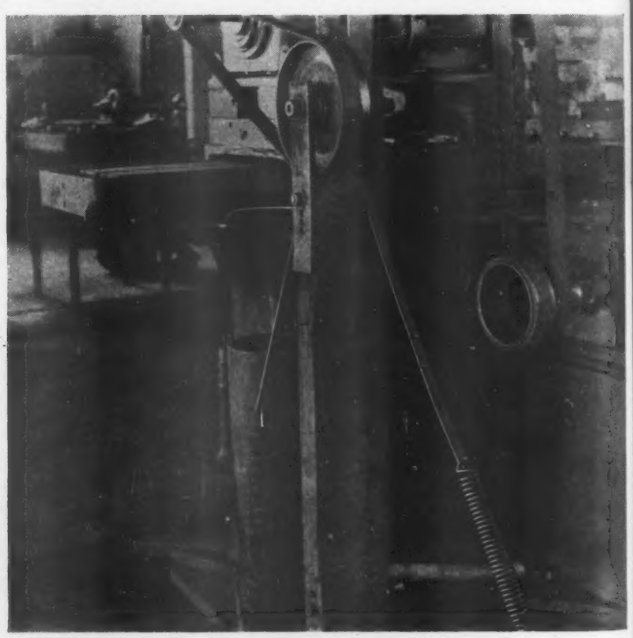
The cylinders are held in position on the truck by means of chains which are adjustable to accommodate cylinders of different sizes.

The truck has 12-in. cast-iron wheels with 2-in. tires. These facilitate easy handling of the truck especially when swinging it from the upright to the rolling position. The axle is bolted to the frame, permitting rapid dismantling for shipment or storage.

The overall size of the No. 5 cylinder truck is 48 in. high by 30 in. wide. Its weight is 80 lb. It is finished with a rust-preventing black enamel.

Eccentric Drive for An Internal Grinder

A SIMPLE method of rigging a belt drive to the eccentric pulley of an internal grinder is to use a double-pulley arrangement as shown in the illustration. One pulley has a diameter of 4 in. and the other is 10 in. They are mounted between two sections of ½-in. by 2-in. strap bolted to the top of a 3-in. by 6-in. strap, the



Method of rigging a belt drive to the eccentric pulley of an internal grinder

bottom end of which is hinged to the floor by two similar straps and a bolt. The bottom ends of these straps are bolted to the floor.

A short belt from the eccentric pulley is placed over the 10-in. pulley and another belt runs from the 4-in. pulley to the drive shaft overhead. Flexibility is imparted by an 18-in. section of 1½-in. coil spring, attached to the top of the post by a small strap and to an eyelet in the floor. Several small holes in the end of the strap allow for adjustment of the spring for tension.

(Turn to next left-hand page)

COLD WEATHER
WON'T WEAKEN THESE FORGINGS

EPIDEMICS of forging failures have long been associated with the advent of cold weather on the railroads. » Ordinary forging steels become brittle at the low temperatures encountered on Northern roads. But Republic metallurgists found an answer to this as they have to so many railroad steel problems. » An Agathon Alloy forging steel was developed that retains its strength and toughness at any atmospheric temperature. Failures due to cold weather brittleness are now a thing of the past. » Once again from the laboratories of Republic has come a better material to reduce repair costs and prolong the life of equipment. » Wherever you use iron or steel consult Republic Steel Corporation for better materials.

Toncan Iron Boiler Tubes, Pipe, Plates, Culverts, Rivets, Staybolts, Tender Plates and Firebox Sheets • Sheets and Strip for special railroad purposes • Agathon Alloy Steels for Locomotive Parts • Agathon Engine Bolt Steel • Agathon Iron for pins and bushings • Agathon Staybolt Iron • Climax Steel Staybolts • Upson Bolts and Nuts • Track Material, Maney Guard Rail Assemblies • Enduro Stainless Steel for dining car equipment, for refrigeration cars and for firebox sheets • Agathon Nickel Forging Steel.

CENTRAL ALLOY DIVISION

REPUBLIC STEEL
CORPORATION
MASSILLON OHIO

AGATHON STEELS

Among the Clubs and Associations

NORTHWEST CAR MEN'S ASSOCIATION.—Changes in the new A. R. A. interchange rules are to be discussed at the February 6 meeting of the Northwest Car Men's Association which will be held at 8 p. m. at the Minnesota Transfer Y. M. C. A. Gymnasium, St. Paul, Minn.

CANADIAN RAILWAY CLUB.—Bernard Allen, assistant economist, Canadian National Railways, Montreal, will discuss Highway Service at the meeting of the Canadian Railway Club which will be held at 8 p. m. on February 13 at the Windsor Hotel, Montreal.

NEW ENGLAND RAILROAD CLUB.—"Air Conditioning of Passenger Cars" will be discussed by O. C. Cromwell, assistant chief of motive power and equipment, and W. R. Whitsitt, mechanical engineer, of the Baltimore & Ohio, at the February 14 meeting of the New England Railroad Club which will be held at the Hotel Statler, Boston, Mass., following a banquet at 6:30 p. m.

Club Papers

Economic Motive Power Life

WESTERN RAILWAY CLUB.—Meeting held Monday evening, January 16, at the Hotel Sherman, Chicago. Subject "The Relation of Locomotive Operation to Railroad Net Operating Income," by Thomas R. Cook, manager, inspection and field service, The Baldwin Locomotive Works, Philadelphia, Pa. ¶This paper, effectively illustrated with lantern slides to give a graphic presentation of trends in the motive-power field, showed the direct bearing which locomotive performance has on net operating income, this effect being of such a magnitude that it constitutes one of the most important points of attack in the endeavor to reduce operating expenses. Among other trends clearly shown in the paper is the rapidly-mounting cost of locomotive maintenance in the case of older power. ¶The possibility of predicting the economic life of new power was also clearly brought out in the paper. The curve covering this feature indicated that the economic life of new locomotives in one case studied varies from 12 to 16 years and that, for a shorter life than this, there will be an increase in total operating expense reaching a figure of $322,000 for a five-year life. The continuance of the locomotives in service after 16 years, however, will be accompanied by a rising cost of operation from, roughly, $295,000 a year to $311,000, at a life of 33 years. When it is considered that these figures cover the service of three locomotives only, the importance of a correct determination of the economic life of power and its replacement by new power at the expiration of this economic life becomes apparent. ¶The objectives and conclusions of Mr. Cook's paper are summarized in the following closing paragraph: "We have attempted to point out in this paper the possibilities of greatly decreasing the expenses which revolve around the use of locomotives. This decrease in expenses would become net operating income. When it is realized that over one-third of all operating expenses are controlled by locotive use, these savings could gradually, through wider and wider use of new power, amount to some hundreds of millions of dollars annually. In no other phase of railroad operation is there anything like an equal opportunity to contribute to that rehabilitation of railroad earning power which is so sorely needed."

Directory

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—T. L. Burton, Room 5605 Grand Central Terminal Building, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—F. W. Venton, Crane Company, Chicago.

AMERICAN RAILWAY ASSOCIATION.—Division V.—MECHANICAL.—V. R. Hawthorne, 59 East Van Buren street, Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION—V. R. Hawthorne, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey street, New York.

DIVISION I.—SAFETY SECTION.—J. C. Caviston, 30 Vesey street, New York.

DIVISION VIII.—CAR SERVICE DIVISION.—C. A. Buch, Seventeenth and H streets, Washington, D. C.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth street, New York.

RAILROAD DIVISION.—Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church street.

MACHINE SHOP PRACTICE DIVISION.—R. E. W. Harrison, 6373 Beechmont avenue, Mt. Washington, Cincinnati, Ohio.

MATERIALS HANDLING DIVISION.—M. W. Potts, Alvey-Ferguson Company, 1440 Broadway, New York.

OIL AND GAS POWER DIVISION.—Edgar J. Kates, 1350 Broadway, New York.

FUELS DIVISION.—W. G. Christy, Department of Health Regulation, Court House, Jersey City, N. J.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 7016 Euclid avenue, Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce street, Philadelphia, Pa.

AMERICAN WELDING SOCIETY.—Miss M. M. Kelly, 29 West Thirty-ninth street, New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—C. R. Crook, 2276 Wilson avenue, Montreal, Que. Regular meetings, second Monday of each month except in June, July and August at Windsor Hotel, Montreal, Que.

CAR DEPARTMENT OFFICERS ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month except June, July and August, Auditorium Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF OMAHA, Council Bluffs and South Omaha Interchange.—Geo. Kriegler, car foreman, Chicago, Burlington & Quincy, Sixteenth avenue and Sixth street, Council Bluffs, Iowa. Regular meetings, second Thursday of each month at Council Bluffs.

CENTRAL RAILWAY CLUB OF BUFFALO.—M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meeting, second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

CLEVELAND RAILWAY CLUB.—F. B. Frericks, 14416 Alder avenue, Cleveland, Ohio. Meeting second Monday each month, except June, July and August, at the Auditorium Hotel, East Sixth and St. Clair avenue, Cleveland.

EASTERN CAR FOREMEN'S ASSOCIATION.—E. L. Brown, care of the Baltimore & Ohio, Staten Island, N. Y. Regular meetings, fourth Friday of each month, except June, July, August and September.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—P. M. Pursian, chief clerk to superintendent of shops. C. C. C. & St. L., Beech Grove, Ind. Regular meetings first Monday of each month, except July, August and September at Hotel Severin, Indianapolis, at 7 p. m. Noon-day luncheon, 12:15 p. m. for Executive Committee and men interested in the car department.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—T. D. Smith, 1660 Old Colony building, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha street, Winona, Minn.

MASTER BOILERMAKER'S ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

NATIONAL SAFETY COUNCIL—STEAM RAILROAD SECTION.—W. A. Booth, Canadian National, Montreal, Que.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meeting, second Tuesday in each month, excepting June, July, August and September, Hotel Statler, Boston.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meeting, third Friday in each month, except June, July and August, at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meeting first Monday each month, except June, July and August, at Minnesota Transfer Y. M. C. A. Gymnasium building, St. Paul.

PACIFIC RAILWAY CLUB.—W. S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY BUSINESS ASSOCIATION.—P. H. Middleton (Treas. and Asst. Sec.), First National Bank building, Chicago.

RAILWAY CAR MEN'S CLUB OF PEORIA AND PEKIN.—C. L. Roberts, R. F. D. 5, Peoria, Ill.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1841 Oliver building, Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August, Ft. Pitt Hotel, Pittsburgh, Pa.

RAILWAY FIRE PROTECTION ASSOCIATION.—R. P. Hackett, Baltimore & Ohio, Baltimore, Md.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 1841 Oliver building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, American Railway Association.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July, September and November. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

SUPPLY MEN'S ASSOCIATION.—E. H. Hancock, treasurer, Louisville Varnish Company, Louisville, Ky. Meets with Equipment Painting Section, Mechanical Division American Railway Association.

TORONTO RAILWAY CLUB.—N. A. Walford, district supervisor car service, Canadian National, Toronto, Ont. Meetings first Friday of each month except June, July and August.

TRAVELING ENGINEER'S ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth street, Cleveland, Ohio.

WESTERN RAILWAY CLUB.—J. H. Nash, 1101 Peoples Gas building, Chicago. Regular meetings third Monday in each month except June, July, August and September.

(Turn to next left-hand page)

The Maintenance It Saves *justifies . . .*

THE LOCOMOTIVE BOOSTER

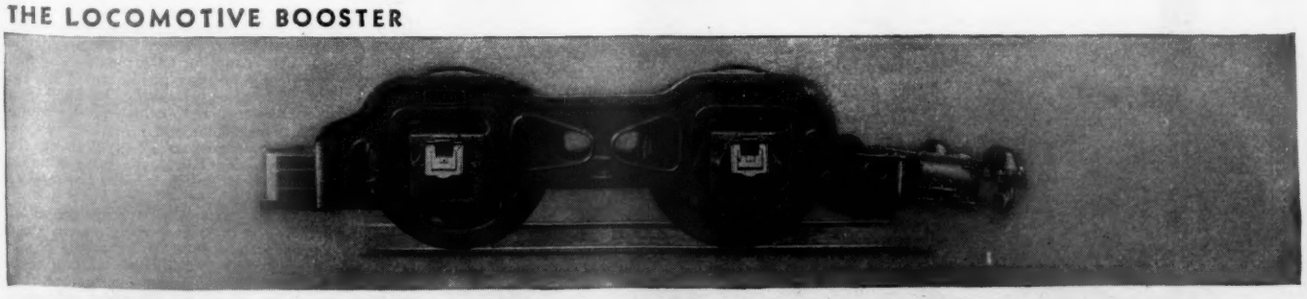
Since locomotive maintenance is about proportional to piston thrust, every locomotive, large or small, will save money with The Locomotive Booster.

The Locomotive Booster is a reserve of power for maximum tractive effort in starting and on grades. Use it and the main locomotive can then be designed with a lower piston speed and thrust and still have ample power to haul the load at operating speeds. The lower piston thrust means lower all-round maintenance.

Here is a saving not always credited to The Locomotive Booster, yet this same maintenance economy is sufficient in itself to justify Booster application.

Franklin has information on this phase of Booster economies it would be glad to present to you.

THE LOCOMOTIVE BOOSTER



FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

NEWS

THE CHICAGO, BURLINGTON & QUINCY has ordered three 60-ton Diesel electric switching locomotives from the Midwest Locomotive Works.

THE NORTHERN PACIFIC has purchased the Timken roller-bearing steam locomotive. This locomotive, which is of the 4-8-4 type, was built by the American Locomotive Company for the Timken Roller Bearing Company for the purpose of demonstrating the practicability and efficiency of roller bearings and has been in experimental service on various railroads throughout the United States. It will be used by the Northern Pacific to haul the North Coast Limited over the Cascade mountains between Seattle, Wash., and Ellensburg.

Model of "Old Ironsides" Presented to Franklin Institute

A MODEL of Old Ironsides, the first locomotive built by Matthias W. Baldwin, founder of the Baldwin Locomotive Works, was presented January 9, 1933, to the Franklin Institute, Philadelphia, Pa., by Samuel M. Vauclain, chairman of the board. In addition to this gift, they also presented a photographic report of the Arbitration Committee which ordered payment for the locomotive to Baldwin and which rendered its decision on January 10, 1833, and photographs of the water-colored portrait of Matthias W. Baldwin, the original of which is in possession of the Baldwin Locomotive Works, and of the bronze statue of the founder of the works which was recently erected in front of the office building at Eddystone.

Old Ironsides was ordered by the Philadelphia, Germantown and Norristown Railroad. The locomotive was destroyed by a landslide. There was a dispute between Mr. Baldwin and the railroad relative to paying for the locomotive and the Arbitration Committee mentioned was created to decide this dispute. One of the signers of the arbitration award was Samuel Vaughan Merrick who was one of the two founders in 1824 of the Franklin Institute. In his presentation speech Mr. Vaughan outlined the part Mr. Merrick took in the founding in 1836 of the Southwark Foundry & Machine Company which is now a part of the Baldwin organization.

The gifts were accepted on behalf of the Institute by Dr. Howard McClenahan, secretary of the Franklin Institute Museum, with whom were associated W. Chattin Wetherill and Walton Forstall.

Model of "Old Ironsides" presented to the Franklin Institute

Wage Conference

TWENTY-ONE PRESIDENTS of labor organizations and their 1500 chairmen and a committee representing the railroads were present at the wage conference which opened at Chicago on December 12 to seek an indeterminate extension of the 10 per cent wage reduction which expired February 1, 1933. Negotiations were concluded shortly after midnight on December 22, when, after failure to agree seemed certain, the conference committee of managers and the 21 labor executives signed an agreement extending the deduction of 10 per cent in basic rates of pay until October 31, 1933. The agreement also provides that if either side wishes to change the basic rates, action toward that end may not be initiated prior to June 15, 1933. Prior to the agreement the union executives had contended for an extension of the deduction for a period of a year, and the managements wished to terminate it in six months.

The agreement, verbatim, is as follows: "It is agreed between the parties hereto that the original agreement is hereby extended so that up to and including October 31, 1933, ten per cent shall be deducted from each pay check of each of the employees covered by this agreement; that basic rates of pay shall remain as under the original agreement; that this agreement shall terminate automatically October 31, 1933, and that neither party prior to June 15, 1933, will serve notice of a desire to change or extend this agreement, or of an intended change in basic rates of pay, such change or extension to become effective on or after November 1, 1933; it being further agreed that in the event that such a notice should be served by any party hereto between June 15, 1933, and November 1, 1933, the proceedings thereunder shall be conducted pursuant to the provisions of the Railway Labor Act and such proceedings shall be conducted nationally in order that the matter may be handled to a conclusion as expeditiously as reasonably possible."

Power Reverse Gear Required by I. C. C.

A FINDING that the safety of employees and travelers on railroads requires that all steam locomotives built on or after April 1, 1933, be equipped with a suitable type of power-operated reverse gear was announced by Division 6 of the Interstate Commerce Commission, Commissioners Eastman, McManamy and Lee, at Washington, D. C., on January 18 following an investigation held on a complaint filed by the Brotherhood of Locomotive Engineers and the Brotherhood of Locomotive Firemen and Enginemen. It was further found that all steam locomotives used in road service built prior to April 1, 1933, which weigh on driving wheels 150,000 pounds or more, and all used in switching service which weigh on driving wheels 130,000 pounds or more, shall have such power-operated reverse gear applied the first time they are given repairs of Class 3 or heavier, and that all such locomotives shall be so equipped before January 1, 1937. The division further found that air-operated power reverse gear should have a suitable steam connection so arranged and maintained that it can be quickly used in case of air failure. This was accompanied by an order amending the rules for the inspection and testing of steam locomotives and tenders and their appurtenances to give effect to the findings. Following are extracts from the report:

While certain accidents are now attributed by defendants to the fact that the locomotives were equipped with power reverse gear, it is significant that in no case was the power reverse gear removed after the accident and hand reverse substituted. The locomotives involved, if in use, are still equipped with power reverse gear.

The record shows that during the 5-year period from 1925 to 1929, inclusive, there were 1,116 casualties due to reverse gear. The proportion of such casualties occurring on locomotives equipped with hand reverse gear is illustrated by the fact that of 232 cases occurring in 1929 and 1930 a total of 216 occurred on locomotives equipped with hand reverse gear and 16 on locomotives equipped with power reverse gear. During the latter period there were about the same number of locomotives in service with power reverse gear as with hand reverse gear.

Defendants state that the average cost of equipping a locomotive with power reverse gear would be approximately $400, and that the power reverse gear is more expensive to maintain than hand reverse gear. Complainants urge that this expense would be offset by increased efficiency obtained from the locomotive, due to faster operation being possible with power reverse gear than with hand reverse gear. Defendants urge, on the contrary, that due to what is generally

termed "creeping" of the power reverse gear, it is less efficient than hand reverse gear.

Clearly the carriers of this country would not have equipped approximately 29,000 locomotives with power reverse gear, and would not contemplate so equipping practically all new locomotives, if such gears did not contribute to efficiency of locomotive operation, or if power reverse gear is less safe than hand reverse gear. The fault termed "creeping" causes no accidents and resolves itself largely into a question of proper maintenance. If the power reverse gears are properly maintained, we think "creeping" to any material extent will be eliminated. Witnesses for the carriers, who were asked the question, were firm in their opinion that we should not require power reverse gear to be removed from present locomotives and hand-operated gears used in lieu thereof.

To draw a line of demarcation which will provide the degree of safety contemplated by the law and yet not cause unnecessary expense on the part of the carriers is not easy. While the accident records do not in all cases show the size of the locomotives on which accidents have occurred, they do indicate that the greater number occurred on the heavier types. Nor are we unmindful of the financial condition of the carriers, which was strongly urged as a reason for denial of the relief here sought. But we cannot believe the present financial condition will be permanent and we are convinced that action should now be initiated to afford relief in the future from the conditions complained of.

Economies To Be Effected in Brake Cleaning

THE AMERICAN RAILWAY ASSOCIATION, Mechanical Division, has revised, effective January 1, 1933, the interchange rules and the maintenance rules pertaining to brake and train-air-signal equipment to provide for an extension of the time for periodically cleaning air brakes from 12 months to 15 months, thus in effect reducing the cost about 25 per cent, or $1 per car per year.

The details of this important action are given in circular No.. D.V.-797, recently issued by the division, covering changes in Interchange Rules 60, 100, 101, 102 and 110. Instructions are also given in the circular regarding the maintenance of brake equipment on freight cars carrying the new experimental Type-AB brake, as follows:

"In order to determine the average length of time these new brake equipments may be operated in service without being cleaned and lubricated, periodical attention must not be given them until a defect develops. Therefore, the Type-AB valve and brake cylinder must not be cleaned nor lubricated.

"When a defect develops in the service of the emergency portion of the Type-AB valve or brake cylinder that will affect the proper operation of the brake, it should be cut out and the car returned to the owner when empty or arrangements made for an inspection and test of the equipment by a representative of the brake manufacturers, who will endeavor to make corrections or supply equipments for replacements. When defects develop in other parts of the brake equipment, repairs may be made in the usual way.

"When a car equipped with the Type-AB brake is on shop or repair tracks where air-brake repairs can be made, the brake equipment should be inspected and tested, as prescribed in maintenance rules for cars having stencils 'In date.'

"Repairs should be made to all parts found defective, except the Type-AB valve and brake cylinder, which should be handled, as prescribed in the second paragraph.

"The single car-testing device, as shown on pages 17 and 18, Sec. B of the Manual of Standard and Recommended Practice, can be used by making the emergency test for Type-AB brakes with the special cock attached to the test device for testing standard brakes on exceptionally long cars.

"Any defects found in the triple valve, cylinder or reservoir of the Type-AB brake should be reported in full detail to G. H. Wood, chairman, Committee on Brakes and Brake Equipment, with a copy to the car owner giving full particulars.

"To date, the Type-AB experimental brake has been applied to the following Pennsylvania X29 box cars, 100,000-lb. capacity, numbered 100,000 to 100,924, inclusive."

Another change made effective January 1, 1933, as announced in the circular, pertains to Interchange Rule 3, Sec. (c), Par. 1, covering coupler requirements on cars built new, on or after August 1, 1932. This date is extended to August 1, 1933. Similarly, in Par. 2 of the same rule and section, the effective date of the requirement is extended to August 1, 1933.

New York-Philadelphia Electric Service Started

ELECTRIC PASSENGER TRAIN service between New York and Philadelphia, Pa., was inaugurated by the Pennsylvania on January 16 when the 9 a. m. train for Philadelphia, drawn by an electric locomotive, left Pennsylvania station, New York. The first electric train on the run from Philadelphia to New York left Broad Street Station, Philadelphia, at 1:00 p. m. the same day. Appropriate ceremonies, in which Mayor John P. O'Brien of New York and Mayor J. Hampton Moore of Philadelphia participated, marked the respective train departures on these inaugural runs.

Initial electric train service consists of four daily round trips. It will be increased, gradually, until the entire schedule of trains between these two cities is electrically operated. For this purpose, 12 modern electric locomotives will constantly be in use. At present, no change in the schedules of trains will be made.

Announcement was also made on January 16 by M. W. Clement, vice-president of the Pennsylvania in charge of operation, that the through trains between New York and Washington, D. C., will begin running under electric power as far south as Wilmington, Del., some time in March. The change of locomotives will be made at Wilmington while the trains are making the station stop.

Lehigh Valley Spreads Work

E. E. LOOMIS, president of the Lehigh Valley, has notified Alfred P. Sloan, Jr., chairman of the Share-the-Work Movement in the Second Federal Reserve District, that employment on the Lehigh has been considerably increased with adoption of the job-spreading plan. The road's personnel now numbers 13,726, Mr. Loomis reported, noting that 2,500 engineers, firemen and trainmen have agreed upon individual limitation of monthly mileage, so as to put more men on runs.

"In our shops, employing about 4,000 men," Mr. Loomis said, "we have worked the average force three days a week in preference to working a part of the force five days a week, thereby increasing the number of men on the pay roll. In the maintenance of way department, comprising about 2,500 men, the same practice of working the full force three days of the week rather than working a small force for six days a week has been followed."

Negotiations are pending for similar arrangements with telegraphers and other groups of employees. It has not been found practicable to apply the entire plan to clerical and station forces but some modification, designed to spread such work as far as possible, is contemplated.

Supply Trade Notes

THE BABCOCK & WILCOX TUBE COMPANY, New York, has appointed Fritz Hoving its West Coast district sales manager. Mr. Hoving will make his headquarters with A. M. Castle & Company, who are the West Coast agents of the Babcock & Wilcox Company at 2200 East Fifty-fifth street, Los Angeles, Cal.

JOHN M. MULHOLAND, special representative, railroad sales, of the Youngstown Sheet & Tube Company, 111 West Washington street, Chicago, is handling sales of tie plates for the Youngstown Sheet & Tube Company, which are now being manufactured at its Indiana Harbor plant.

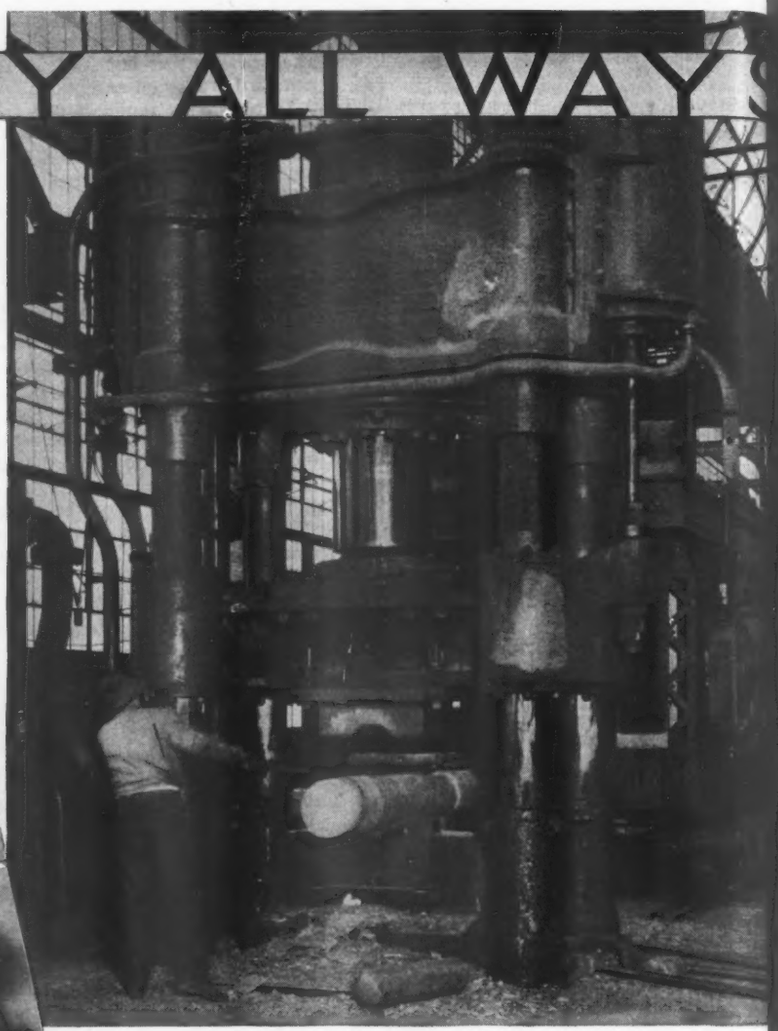
SALES OF THE Agasote Millboard Company's products in the railroad and marine field will continue to be handled by the Pantasote Company, Inc., 250 Park avenue, New York, under the management of William A. Lake, but all orders or contracts for Millboard products will henceforth be subject to acceptance by the Agasote Millboard Company, since all contracts are to be directly between the latter company and the customer.

THE ELECTRO-MOTIVE COMPANY and the Winton Engine Corporation, both divisions of General Motors Corporation, have been consolidated under the name of Winton Engine Corporation, with headquarters as before at Cleveland, Ohio. The consolidation is intended to eliminate over-lapping functions thereby effecting greater efficiency and economy. The established policies of the Electro-Motive Company will be continued and its personnel will carry on the rail car and locomotive activities in the Winton Engine Corporation.

LEROY KRAMER, vice-president of the General American Tank Car Corporation, has also been elected president of the Union Refrigerator Transit Com-

(Continued on next left-hand page)

QUALITY ALL WAY



The infinite care and precision exercised from the
tion and inspection of the billets to final machini
duce superior forgings which enhance the depend
and efficiency of the locomotive.

QUALITY ALWAYS

Alco FORGINGS

FOR ECONOMY—*The Watchword of the Hour*

ECONOMY OF LOW FIRST COST. It is much cheaper for a railroad to buy Alco Forgings than it is to equip, maintain and operate shops to manufacture forgings on as modern and highly technical plane as Alco.

ECONOMY OF HIGH QUALITY. Alco Forgings, backed by years of forging experience, quality materials, metallurgical research and scientific manufacturing methods with ultra-modern equipment — all needed for quality — have that extra measure of dependability to stand the severe stresses of hard service.

ECONOMY OF LOW COST OPERATION. The great uniform strength and durability of Alco Forgings give greatest insurance against engine failures and enable locomotives to produce maximum ton-miles for the fewest maintenance dollars.

American Locomotive Company
30 Church Street New York N.Y.

pany, a subsidiary, to succeed Walter Alexander, who has been elected chairman of the board, with headquarters at Milwaukee, Wis. The headquarters of Mr. Kramer as vice-president of General American and president of the Union Refrigerator Transit Company will continue at Chicago.

W. S. SHIFFER, who has been connected with the Reading Iron Company, Reading, Pa., for some time and recently acting as assistant general manager of sales, has been appointed general manager of sales and J. L. Jacobson, manager of sales in the central region, has been appointed assistant general manager of sales. Both Mr. Shiffer and Mr. Jacobson will be retained in the general sales office, Philadelphia, Pa. G. H. Woodroffe has been appointed manager of boiler tube sales, C. T. Ressler, manager of railroad and marine sales and L. K. Simons, manager of cut nail sales.

THE GENERAL AMERICAN TANK CAR CORPORATION, Chicago, has concluded a 15-year contract with the Chicago, Rock Island & Pacific, taking over the entire refrigerator car service on the Rock Island system. The territory covered includes a large part of the southwest and far west—over 8,000 miles of line. Under the contract the General American Tank Car Corporation takes over the Rock Island's 1,200 refrigerator cars and in return furnishes all the refrigerator car needs of the railroad. The tank car company also agrees to pay a fixed price per month based on mileage and assumes the responsibility of repairs.

Obituary

AUSTIN J. HOWLEY, lubrication engineer of the Standard Oil Company of New Jersey, died on December 30 at his home in Scranton, Pa., following an operation.

I. H. MILLIKEN, vice-president of the McConway & Torley Corporation, died suddenly on December 30 in his office at Pittsburgh, Pa.

BASIL MAGOR, consulting engineer and manufacturer of railroad cars, founder and first president of the Magor Car Corporation, died on January 14 at his home in New York.

WILLIAM J. MCCARROLL, formerly assistant to the senior vice-president of the Baldwin Locomotive Works, died on December 31 at his home at Melrose Park, Pa., at the age of 72. Mr. McCarroll retired in 1928. For many years he was foreign representative of the Baldwin Locomotive Works and passed a considerable part of his life in Russia and Italy.

GEORGE M. BARD, chairman of the board of the Barco Manufacturing Company, Chicago, who died in that city on December 21, was born in Alliance, Ohio, on July 22, 1852, and from 1869 to 1891, engaged in the hardware and the iron and steel business at Cleveland. In the latter year he became treasurer and manager of the Indiana Iron Company, Muncie, Ind., which position he held until 1899, when he became general superintendent and a director of the Republic Iron & Steel Company. In 1901, he resigned to become president of the Norwall Manufacturing

George M. Bard

Company, which position he held until 1907, when he became president of the Barco Manufacturing Company. He held this position until 1921, when he was elected chairman of the board.

Personal Mention

General

W. H. MCAMIS, superintendent of shops on the Missouri Pacific at North Little Rock, Ark., has been promoted to assistant mechanical superintendent, with headquarters at St. Louis, Mo., to succeed W. G. Seibert, deceased.

FRANCIS G. LISTER, assistant superintendent of motive power of the St. Louis-San Francisco, has been advanced to superintendent of motive power, with headquarters as before at Springfield, Mo., to succeed J. W. Surles, who has resigned.

Master Mechanics and Road Foremen

R. E. HAUSSNER has been appointed assistant master mechanic of the Central Kansas, Colorado and Wichita divisions of the Missouri Pacific at Wichita, Kan., to succeed Richard Kling.

RICHARD KLING, assistant master mechanic of the Central Kansas, Colorado and Wichita divisions of the Missouri Pacific, at Wichita, Kan., has been appointed master mechanic of the Joplin-White River divisions, with headquarters at Nevada, Mo.

GEORGE SCHEPP, master mechanic of the Joplin-White River divisions of the Missouri Pacific, at Nevada, Mo., has been transferred to the position of master mechanic of the Central Kansas, Colorado & Wichita divisions, with headquarters at Osawatomie, Kan.

Car Department

EDWARD ELEY, master car builder, Eastern lines, of the Canadian Pacific, retired on January 1. Mr. Eley entered the railway's service in 1889, as a carpenter in the bridge and building department at North Bay, Ont. In 1894, he was transferred to the car department and later served as car foreman at Quebec and Glen Yards. In 1911 he was promoted to general foreman at West Toronto; in 1912, became division car foreman at North Bay, and in 1915, was advanced to master car builder.

Shop and Enginehouse

G. T. CALLENDER, master mechanic of the Central Kansas, Colorado and Wichita divisions of the Missouri Pacific, at Osawatomie, Kan., has been appointed superintendent of shops at North Little Rock, Ark., to succeed W. H. McAmis.

Purchasing and Stores

M. C. NYSTROM, chief clerk in the purchasing department of the Southern Pacific, Pacific Lines, at San Francisco, Cal., has been promoted to assistant purchasing agent, with the same headquarters.

H. M. RAINIE, assistant to the purchasing agent of the Boston & Maine, has been appointed purchasing agent, succeeding A. W. Munster, who has been promoted to vice-president in charge of purchases and stores of the Boston & Maine and the Maine Central.

Obituary

W. H. V. ROSING, formerly mechanical engineer of the Missouri Pacific and later assistant to the president of the St. Louis-San Francisco, who retired as special engineer for the latter road in 1917, died at St. Louis, Mo., on January 11, at the age of 73 years.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

WROUGHT IRON.—"The Welding of Genuine Wrought Iron," a four-page folder published by the A. M. Byers Company, Pittsburgh, Pa., contains some interesting practical information on the proper procedure for welding wrought iron. Engineering data on other properties and characteristics of wrought iron are also included in this folder.

FEEDWATER HEATERS.—Bulletin H-3, issued by the Superheater Company, 60 East Forty-second street, New York, is an order list of parts for Elesco feedwater heaters. It is divided into three sections, with the various parts segregated under the general headings Heater Parts, Pump Parts and Miscellaneous parts. Detailed instructions on ordering the parts listed are given at the beginning of each section.